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THE EFFECTS OF DLA IPG I SURCHARGES ON
DDRW END USER ACTIVITY INVENTORY POLICIES

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December, 1992

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The purpose of this thesis is to examine the effects on retail customers of surcharges proposed by the Defense Logistics Agency (DLA) on Issue Priority Group I (IPG I) requisitions. The intent of these surcharges is to enable DLA to recapture a portion of the costs incurred in meeting IPG I time standards. Additional goals are to discourage IPG I requisitioning for frivolous reasons, and when maintenance of small retail inventories may be less costly to the government.

Data was collected from the Naval Supply Centers at Oakland and San Diego, and the former Sharpe Army Depot, now incorporated with Defense Depot San Joaquin (DDJC). Two types of surcharges were applied to this data. A variety of flat rates per requisition were examined. Alternately, several percentage levels were applied to an item's unit price to test their effectiveness as surcharges. Combinations of flat and percentage rates were also studied.

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ABSTRACT

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I. PROBLEM, OBJECTIVES, SCOPE, AND PREVIEW

A. THE PROBLEM

In the late fall of 1991, CDR John Corbett, Director of Warehousing Division, Defense Distribution Depot Oakland (DDOC), was faced with an impasse concerning Oakland's continued viability as a stock point. Specifically, CDR Corbett periodically reviewed Oakland's requisitioning histories and conducted random samples of Issue Priority Group I (IPG I) requisitions received. His analysis revealed a disproportionate amount of IPG I requisitions relative to other Defense Logistics Agency (DLA) stock points in Central California. These IPG I requisitions were a principal cause of Oakland's higher cost to issue material when compared to nearby Defense Depots in California's central valley. C D R Corbett felt these costs may tip the scales in favor of eliminating Oakland as a DLA stock point and transferring its inventories to the San Joaquin Valley (Corbett '91).

In essence, CDR Corbett was faced with several DLA alternatives. These choices included: (1) subjectively downgrading requisitions he believed did not meet IPG I criteria; (2) assisting his most prolific IPG I customers to build inventories of the materials they ordered the most as IPG I; and (3) imposing penalties in the form of surcharges

on IPG I requisitions to recoup his additional costs to fill these requirements. CDR Corbett was concerned about the effects of this proposed surcharge on his customers. He requested a study of the second and third alternatives as a thesis conducted by inventory and logistics masters degree students at the Naval Postgraduate School (NPS).

B. RESEARCH OBJECTIVES

This thesis will examine the effects of a DLA IPG I requisitioning surcharge on ordering decisions and inventory management by retail activities. It will construct a logical framework within which an efficient decision maker can weigh all pertinent issues and find an optimal compromise. This framework could also be used by wholesale activities to determine the effects of contemplated surcharge policy changes on retail customers prior to implementation. Wholesale activities may be able to extrapolate an approximation of income at various surcharge levels and combinations. These approximations could be of use in designing surcharge programs that accurately reflect the additional costs of providing high priority responsiveness.

C. SCOPE

1. Data

Data was collected from three stock points in Defense Distribution Region West (DDRW): Naval Supply Centers (NSC)

Oakland and San Diego, and DDRW Sharpe facility. Oakland was chosen as it was the originator of the study proposal and for its proximity to Monterey and NPS. To validate Oakland's analysis San Diego was added. Finally, the former Sharpe Army Depot, DDRW Sharpe, was queried to enable testing with predominantly non-Navy data.

Each activity was as..ed to provide requisition histories for all IPGs from 1 June 1991 through 30 May 1992. There were several reasons why this particular period was chosen. First, by the end of May 1991 three months had elapsed since the conclusion of Operation Desert Storm. This three-month period allowed the glut of requisitions accumulated during Desert Storm to pass completely through the supply system. During the Gulf War, the Defense Supply System was inundated with unique IPG I requirements. In war, operational needs clearly dominate decision makers' thoughts; neither DLA nor their retail customers would be concerned with the effects of a surcharge. To attempt to analyze the effects of IPG I surcharges on retail customers using data gathered under these conditions would present a misleading picture and result in erroneous conclusions.

Second, to attempt to analyze data from the period leading up to the Gulf War build-up could also be misleading. DLA began experimenting with methods to implement the proposed stock point consolidation initiative, Defense Management Review Directive (DMRD) 902, during the summer of 1990 using

central California (Oakland, Sacramento, Stockton area) as a test site. Therefore, Oakland and Sharpe data for that time period may have reflected the confusion associated with the extensive organizational changes. In addition, during this period San Diego continued to operate entirely independently as an NSC under Navy control. The use of San Diego data from this period could lead to conclusions based upon circumstances no longer applicable. Finally, if the collection period was set to start later than May 1991, it might have been difficult to collect a complete year's data for analysis.

Oakland and San Diego were able to provide real data for the entire year requested by using their Uniform Automated Data Processing System for Stock Points (UADPS-SP) generated Demand History Files (DHF) and Requisition Status Files (RSF). The data tapes provided by both NSCs' were based on the first sixty-four columns of the standard UADPS-SP RSF layout. Additional requested information was appended to this format in column numbers sixty-five through ninety-three.

Sharpe was only able to supply data from 1 January through 25 August 1992. They were also unable to supply data in UADPS-SP format. Instead, data was provided in Sharpe's Material Release Order (MRO) History program layout. Fortunately, the required information could be extracted from this 205-column layout to form a data base which was comparable with the Navy data base.

2. Model Assumptions

a. Demand

The framework developed in this thesis assumes the deterministic Economic Order Quantity (EOQ) demand-based inventory equation as if inventories are to be held by customers (Tersine '88). Therefore, it will not attempt to address non-demand based inventory strategies on an individual retail customer level such as Consolidated Shipboard Allowance Lists (COSALs), Aviation Consolidated Allowance Lists (AVCALs), Consolidated Shore Based Allowance Lists (COSBALs), and Tables Of Allowances (TOAs).

Many of the demands submitted by industrial activities may be job dependent, but, short of a thorough submittal review, there is no method of differentiating dependent from independent demands. As a result, this surcharge model assumes all demands are independent.

This model assumes all demand to be known and constant. The demand data bases provided by each stock point contained IPG I demands for only nine months (Sharpe) and only one year (Oakland and San Diego) and may not be indicative, as assumed, of annual demand during subsequent years. In reality, demand for an item is a random variable having some probability distribution associated with it. Unfortunately, one year's worth of data was insufficient to develop such a distribution.

b. Lead Time and Requisition Splitting

The lead times are assumed to be known and constant. Historical data does not provide information on the actual lead times. Actual receipt information is usually only retained by the requisitioner in their receipt file. Order and shipping time goals are specified by the Uniform Material Movement and Issue Priority System (UMMIPS). Therefore, lead times were assumed to be known and constant at the goals specified by UMMIPS. Fortunately, neither the TVC nor the EOQ equation used in the model requires an explicit lead time value.

All units of an order are assumed to be added to inventory at the same time. Supply centers will occasionally split or partially fill a customer's requisition. When splitting occurs, the customer's document number is divided into two requisitions by attaching single-digit suffixes to the document number to identify each half of the order. Because each supply center used suffix codes for a variety of purposes, to include requisition splitting in the model would have required identifying partial requisitions through audit of each depot's demand history. The surcharge model, therefore, assumes no requisition splitting. This assumption should be valid since ordering activities are required to take custody of all units in an order when it is received.

c. Costs

A fixed cost structure is assumed and, for the military supply system, this is valid. Order costs are the same regardless of lot size for most retail activities. There are no quantity discounts. The surcharge model does, however, allow order costs to be varied by individual UIC, and holding cost rates to be varied by Cog or fund code. Holding cost rates are applied per service directive as a linear function based on material type (GAO/NSIAD-92-112).

The last cost assumption is that each activity has sufficient capital to procure the annual demand. In addition, to determine if each of the customers identified in each data base had adequate capacity to maintain the requisitioned items in an inventory on site would have required an in-depth study of each activity. Such studies are beyond the scope of this thesis. Activities using this model should be intimately familiar with their own in-house capabilities. They would easily be able to determine if holding inventories were feasible. Thus, the model does not include provisions for capital or capacity constraints.

d. Other Assumptions

Several other assumptions were also made in developing the thesis model. Depot requisition histories do not identify which IPG I requisitions were submitted for items already carried by the ordering activities. If items were carried,

the decision required would be how to adjust inventory levels to respond to increased surcharge costs, not whether the material should be stocked. Because there was no efficient method available to determine from the depot data bases which requisitions were for carried material, all demands were assumed to be for items not carried.

Any decision to bring an item into stock is assumed to not affect a requisitioner's non-IPG I actions. Separate inventory decisions will be made to satisfy non-IPG I demands. In addition, when an inventory is established for IPG I items brought into stock, the model also assumes requisitions to build and replenish this inventory would be submitted using lower, non-IPG I, priorities. This assumption is consistent with UMMIPS requisitioning policy.

The assumption is made that requisitioning activities will behave in a manner that minimizes their material ordering and holding costs; that is, they will follow the model. Undoubtedly, there will be circumstances when customers choose to pay surcharges to attain the responsiveness of IPG I. Although the marginal cost of raising a requisition's IPG can be determined by calculating the increase in Total Variable Cost (TVC), the subjective criteria a decision maker may use in choosing to raise a requisition's priority is impossible to determine. These circumstances can be extremely difficult to address in a decision model based on quantifiable criteria.

These assumptions allow development of a relatively simple and understandable "surcharge effects" model. In order to relax these assumptions, the model would have grown exponentially in complexity without comparable gains in accuracy.

D. PREVIEW

The next chapter will provide the background for the remainder of the thesis. It will discuss UMMIPS IPG I policies. This discussion will be followed by a review of past Department of Defense (DoD) reports of requisitioning priority abuse. The chapter will also address Oakland's concerns in this matter. It will conclude by reviewing the demand bases of all three depots studied in this thesis.

Chapter III will examine the options available to DLA and their customers to address IPG I abuse. It will discuss customer reasons for IPG I ordering, and the implications of expanding customer inventories.

Chapter IV will discuss the development of the model used to conduct the analysis and its application at the depot and retail customer levels.

Chapter V will analyze the three depots' business using A-B-C charts. Then it will present wire diagrams to illustrate model results. Finally, it will present interval tables for number of requisitions per stock number. This chapter will also examine the effects of IPG I surcharges on

the top two IPG I requisitioning activities for Oakland and San Diego.

Chapter VI will consider development of a more inclusive model to address the implications of IPG I surcharges. This discussion will also include a review of model inputs required.

Chapter VII will summarize the thesis. This summary will be followed by conclusions and recommendations.

II. BACKGROUND

A. ISSUE PRIORITY GROUP I

1. IPG I Policy

IPG I is DoD's highest UMMIPS requisitioning priority group and use is theoretically limited to only the most urgent material needs (OPNAVINST 4614.1F). Authorization to use IPG I is based on two criteria.

First, the requisitioner, or activity supported directly by the requisitioner, must be in Force Activity Designator (FAD) category I, II, or III. FAD I is reserved for those units, projects, or forces which are most important militarily in the opinion of the Joint Chiefs of Staff (JCS) and as approved by the Secretary of Defense. FAD II is assigned to U.S. combat, combat ready, and direct combat support forces deployed to or operating from areas outside the fifty states and adjacent waters, Panama, and such other areas as may be designated by the JCS. FAD III is assigned to all other U.S. combat ready and direct combat support forces outside the Continental United States (CONUS) not included under FAD II. FAD IV and below are not authorized to use IPG I unless supporting an activity authorized a higher FAD.

Second, the need that generated the requirement must meet criteria for requisition priorities 01, 02, and 03. These

priorities are reserved for immediate requirements that render the activity unable to perform one or more of its primary missions. For repair and industrial activities (which normally carry a FAD of IV), these requisitioning priorities are also authorized when required for immediate use to eliminate an existing work stoppage (OPNAVINST 4614.1F).

Except for the situation just mentioned, activities not meeting FAD I, II, or III requirements are not authorized to use IPG I, regardless of urgency. In addition, activities designated in FADs I, II, and III may only use IPG I when their needs meet the priority requirements described above.

IPG I time standards are extremely stringent at all steps of the requisitioning process (Table I).

Table I. UMMIPS Time Standards

UMMIPS TIME STANDARDS (number of days)	
A. Requisition Submission	1
B. Passing Action	1
C. Availability Determination	1
D. Depot/Storage Site Processing	1
E. Transportation (CONUS & to overseas POE)	3
F. Overseas Transportation (ex. Western Pacific)	4
(Western Pacific)	5
G. Requisitioner receipt take up	1

These guidelines create additional costs for stock points. Most of these costs are for labor as warehouse personnel are often required to work overtime and non-regular hours. Added costs are incurred as day-shift personnel must pick single IPG I orders as they occur, instead of using the more efficient

method of selecting several orders at the same time as the picker passes through the warehouse.

2. IPG I Practices

In practice, activities may assign high priorities inappropriately for a variety of reasons that comply with neither the letter, nor the spirit, of the UMMIPS. For example, the DoD Inspector General found four Naval shipyards were routinely ordering, as high priority, material for regular ship overhauls when required delivery dates ranged from two and one half months to one year in the future (DoDIG Report No. 88-118).

CDR Corbett's random sampling of IPG I requisitions received by Oakland led him to believe some priorities were incorrectly assigned. IPG I requisitions were occasionally received for large quantities of common nuts, bolts, and other materials normally stocked by industrial activities as Pre-Expended Bin (PEB) items. CDR Corbett felt using IPG I to order PEB material was an indicator of poor customer inventory management practices and an abuse of IPG I (Corbett '92).

Until recently, when each service controlled its own supply system, these priority abuses were often overlooked or tolerated. This permissive climate was radically changed when all services' material support functions were consolidated under DMRD 902.

Among the principal objectives of this consolidation was the elimination of redundant operating capacity such as excess warehouse space or service unique inventory management software. The end of the Cold War added to this excess as the military services began to downsize. In addition, DLA began evaluating in earnest which of their activities should remain open and which should be closed.

B. OAKLAND'S CONCERNS

As discussed earlier, one factor used by DLA in deciding which activities to close is the cost to issue material. This cost criterion places Oakland and other activities with a high proportion of IPG I requisitions at a disadvantage relative to other DLA stock points. This disadvantage is caused by the additional costs necessary to meet IPG I response requirements. Should DLA place significant weight on this criteria, activities with high IPG I demand percentages would be among the first closed.

Supply activities with higher proportions of IPG I requisitions also tend to have higher proportions of customers required to maintain increased degrees of readiness (FAD I, II, or III). To eliminate these customers' closest source of supply may be detrimental to their ability to sustain this required degree of readiness.

Imposition of surcharges on IPG I requisitions is one alternative contemplated by DLA to recoup IPG I expenses and

retain Oakland and similar activities. An additional benefit of IPG I surcharges would be to discourage frivolous high priority requisitions. Theoretically, legitimate IPG I customers would be willing to pay a premium to expedite the receipt of vitally needed material. Trivial IPG I requisitions would be reduced or eliminated as customers would now be faced with additional surcharge-driven costs.

These surcharges may influence retail customers to increase inventory ranges and depths to avoid the need to submit more costly IPG I requisitions. This decrease in IPG I requisitions would reduce supply system stress as inventory replenishment requisitions would not require monitoring by both depot and customers expeditors. Finally, readiness would be enhanced as material shortfalls were eliminated through use of retail inventories. Remaining IPG I requisitions visible to the system should be legitimate high priority requirements.

The quandary CDR Corbett faced can be summarized as follows: (1) Concern for Oakland's continued viability as a stock point would favor imposition of surcharges to reduce the abuse and quantity of IPG I requisitions. Oakland would also be compensated for IPG I requirements by surcharge revenues. (2) These benefits are mitigated by concern for Oakland's retail customers. In an era of austere funding, these customers would be forced to pay additional costs to use IPG I to fulfill legitimate urgent material requirements. CDR

Corbett submitted this problem to NPS as a prospective thesis topic.

C. DEPOT DEMAND BASE REVIEW

To study the impact of DLA's proposed IPG I surcharge policy, three DDRW stock point customer bases were examined. Each depot's customer base is discussed in the following subsections.

1. Oakland

a. History

Defense Depot Oakland Center (DDOC) was established at the beginning of World War II as a Naval Supply Center (NSC). NSC Oakland served as the principal distribution point for support of fleet operations in the Pacific and Indian Oceans.

During World War II, Oakland operated around the clock to supply U.S. Forces with 28 million tons of material per year. In the late 1960s, Oakland served as the main continental U.S. (CONUS) source of logistical support to Vietnam. In a one-year period, Oakland issued enough material to cover 250 football fields to a height of four feet. (DDOCPRD '92)

After the Vietnam war, NSC Oakland continued to provide logistics support for U.S. military activities throughout the Pacific and central California. It also became a principal transshipment point for surface shipments to all types of U.S. government activities throughout the Pacific.

In 1983, a state-of-the-art automated material handling system was integrated with a computer software system into the

Naval Integrated Storage Tracking and Retrieval System (NISTARS). This resulted in one of the most modern physical distribution facilities in the world and served as the prototype for the Naval Supply System.

In 1989, NSC Oakland, along with other central California DoD Supply Activities, was designated to participate in the DMRD 902 Supply Depot Consolidation prototype. In June 1990, the distribution functions and resources were transferred from the Naval Supply Center Oakland to Defense Distribution Region West to form the consolidation prototype. After the distribution functions were consolidated under Defense Logistics Agency management in 1990, major Navy missions remaining at Naval Supply Center Oakland include regional finance and contracting, personal property, base operations, and the fuel pier at Point Molate.

Storage and retrieval functions in Oakland's principal warehouse continue to be controlled by NISTARS, which is designed to interface with NSC's Uniform Automated Data Processing System for stock points (UADPS-SP) and is not compatible with DDRW's DLA Warehousing And Shipping Procedures (DWASP) system. To overcome this incompatibility, NSC Oakland's UADPS-SP system is used to manage DLA materials held in the NISTARS warehouse.

Inventory management in Oakland is also affected by the continuing transfer of consumables from the Navy to DLA under

DoD's Consumable Item Transfer (CIT) program (Corbett '92). As control of this material is assumed by DLA, many line items are being transferred from Oakland to either Sharpe or Tracy. This physical transfer of materials to DLA, and consolidation within DDRW facilities, is not expected to be completed for some time to come.

b. Customer Base

Naval aviation maintenance units dominate DDOC's demand base. The complete customer base in shown in Appendix A. They are responsible for over forty-seven percent of all IPG I requisitions received by DDOC. In addition, twenty-eight of the top fifty IPG I ordering UICs during the period studied are aviation units. These UICs are listed in descending number of requisitions submitted in Table IV. Naval Aviation Depot (NADEP) Alameda is, by a large margin, DDOC's most prolific IPG I requisitioner. Its primary mission is to perform depot level maintenance on aircraft airframes, avionics, engines, and other systems. In addition, a significant portion of NADEP's workload is to recondition Depot Level Repairables (DLRs). DLRs are usually expensive system components that are repaired when inoperable and released as fully repaired and ready for use assets to the Navy supply system.

The Uniform Material Movement and Issue Priority System (UMMIPS) allows industrial activities to order using IPG I to

Table II. Aviation Units among Top Fifty DDOC IPG I ordering UICs.

UIC	Unit
65885	NADEP Alameda, CA
00296	NAS Moffett Field, Mountain View, CA
00334	NAS Barbers Point, HI
48758	Naval Air Pacific Repair Activity Plant Detachment Office, Atsugi, JA
21297	USS ABRAHAM LINCOLN (CVN-72)
00620	NAS Whidbey Island, WA
00236	NAS Alameda, CA
61577	NAS Guam, MI
62876	NAS Cubi Point, RP
09124	MALS 24, Kanoehe Bay, HI
03362	USS INDEPENDENCE (CV-62)
60200	NAS Cecil Field, Jacksonville, FL
09112	MALS 12
60462	NAS Adak, AK
60259	NAS Miramar, CA
68212	NAF Misawa, JA
65886	NADEP NAS Jacksonville, FL
65923	Marine Aviation Depot, Cherry Point, NC
09136	MALS 36
00421	Naval Air Test Center, Patuxent River, MD
65888	NADEP NAS North Island, CA
09111	MALS 11 (Rear), 3rd MAW, MCAS El Toro, CA
48759	Naval Air Repair Activity Det., Kimhae, SK
60087	NAS Brunswick, ME
68753	Naval Air Pacific Repair Activity Det., Singapore
03366	USS AMERICA (CV-66)
00207	NAS Jacksonville, FL
03369	USS DWIGHT D EISENHOWER (CVN-69)

eliminate existing work stoppage. (OPNAVINST 4614.1F) Hence, as an industrial activity, NADEP (FAD IV) may use IPG I under these circumstances. NADEP further uses IPG I to restock Pre-Expended Bin (PEB) items when necessary. PEB items are low value, common use consumable materials that are stocked in bulk and issued as needed without documentation. They are restocked when predetermined low limits, based on demand

history and lead time, are reached. At present, NADEP does not have either a two-bin, kanban, or other system, to easily determine when low limits have been reached.

As described by Mr J. Wilcoxen, NADEP Alameda's Material Manager, a significant portion of NADEP's IPG I requisitions are generated as a result of Naval Air Systems Command (NAVAIR) DLR Turn-Around Time (TAT) standards. For some critical DLRs, TAT allowances can be as short as fifteen days from initial diagnostic inspection until reissue as an operational asset. Since part requirements are virtually unknown until initial inspections are complete, IPG I is often necessary to insure these parts are received in sufficient time to allow completion of repairs by the deadline.

Finally, NADEP management takes a liberal view of the UMMIPS definition of work stoppage. If planning or progress review reveals that a delay may occur in completion of a job due to lack of materials, NADEP will requisition using IPG I to prevent this possible delay.

Other aviation maintenance units contributing to the high proportion of Oakland's IPG I customer base include Naval Air Stations (NAS) (FAD III) and Marine Aviation Logistics Squadrons (MALS) (FAD III). Both activity types perform essentially the same aircraft maintenance mission as NADEP, but at intermediate levels. Intermediate maintenance is less

complex than depot levels. Their IPG I requirements are also generated to eliminate work stoppage.

In addition, materials are habitually required to meet urgent operational commitments of shore-based patrol squadrons. In particular, NAS Moffett Field generates copious IPG I requisitions to support P-3 Orion squadrons. These IPG I requirements are expected to continue and may actually increase temporarily as Moffett Field draws down its storeroom stocks in light of the closure of the Navy's facilities at Moffett Field and the anticipated transfer of the facilities to the National Aeronautics and Space Administration (NASA), a current tenant of the base.

Oakland's major IPG I requisitioning constituencies also include other types of industrial activities. In particular, Mare Island Naval Shipyard is Oakland's second highest IPG I requisitioning customer. These requisitions are placed primarily in support of depot level overhauls of nuclear submarines.

In addition to Mare Island, other Naval Shipyards (NSY) such as Bremerton, Long Beach, and Pearl Harbor; Ship Repair Facilities (SRF) such as Yokosuka, Subic Bay, and Guam; and Ship's Intermediate Maintenance Facilities (SIMA) such as San Francisco, San Diego, and Pearl Harbor, contribute significantly to Oakland's IPG I demand base. These activities perform depot (NSYs) and intermediate (SRFs and SIMAs) level maintenance on all types of ships and submarines.

As with aviation industrial activities, these units are allowed to use IPG I to eliminate work stoppage. Finally, SRF Guam and other forward positioned activities often perform emergent voyage repairs on deployed ships. IPG I requisitioning is often required to complete these repairs in a timely manner in order to allow the ship to meet operational commitments.

The Bay Area is the homeport for eighteen ships including two nuclear-powered aircraft carriers, three nuclear cruisers, two reserve frigates and various logistics support ships. These operational units constitute the final major sources of IPG I requisitions. Because they are required to maintain full mission capability at all times, they may requisition using IPG I to restore mission debilitating equipment casualties or to meet operational commitments. These ships are also authorized to use higher requisitioning priorities within IPG I because they are FAD I and II activities. Finally, combatant ships are FAD I and are allowed to use IPG I priorities to meet operational commitments.

2. San Diego

a. History

Naval Supply Depot (NSD) San Diego was established in 1922 to serve the needs of the growing number of Pacific Fleet ships stationed in Southern California. At that time the

first official permanent Navy logistics establishment in San Diego, the La Playa Coaling Station at Point Loma, was also merged with the NSD. NSD received its first materials in February 1923.

In 1941, the first Navy pier was built. Prior to construction of this pier, replenishment of ships could only be accomplished by boat. As the fleet grew to meet the demands of World War II, NSD also expanded. As part of this increase, a south wing was added to the original six-story supply depot, and a seven-story warehouse was constructed next door in 1943.

NSD continued to expand after World War II as eight warehouses were constructed at the Naval Station Annex to support expanding material storage needs. By the end of the fifties, NSD's customer base had grown significantly. As a result, in 1959 it was recommissioned as the Navy Supply Center (NSC), San Diego.

In 1973, NSC San Diego assumed logistics support for Long Beach Naval Station, ships homeported in Long Beach, and Long Beach Naval Shipyard. NSD Long Beach was then closed as part of a Navy initiative to streamline shore establishments. In 1980, as a consequence of another consolidation effort, NSC San Diego assumed responsibility for aviation material and absorbed functions previously performed by the NAS North Island Supply Department.

Recently, NSC San Diego turned over its physical distribution operations to DLA and its payroll operations to the Defense Finance and Accounting Center (DFAC). These changes occurred as a result of DoD's DMRD to streamline operations.

In addition, NSC maintains a fuel department which stores more than a million barrels of aviation and shipboard fuels. Each year there is an annual throughput of more than twelve million barrels. NSC's contracting departments also buy more than 75 million dollars worth of spare parts and services per year, primarily from local vendors.

Finally, as a result of the recent DMRDs, NSC San Diego has become the west coast pilot location for the Fleet Industrial Supply Center (FISC) concept. Today, as FISC San Diego, the center operates in Southern California from Long Beach in the north to Point Loma in the south and employs more than 750 civilians and 31 military personnel.

b. Customer Base

As with DDOC, naval aviation maintenance units dominate DDDC's demand base. The complete customer base in shown in Appendix B. They are responsible for over fifty-nine percent of all IPG I requisitions received by DDDC. In addition, thirty-eight of the top seventy-five IPG I ordering UICs during the period studied are aviation units. These UICs are

listed in descending number of requisitions submitted in Table III.

Table III. Aviation Units among Top Seventy-Five San Diego IPG I Ordering UICs.

UIC	UNIT
65888	NADEP North Island, San Diego, CA
60258	NSY Long Beach, CA
60259	NAS Miramar, CA
00246	NAS North Island, San Diego, CA
63126	PMTC Point Mugu, CA
63042	NAS Lemoore, CA
09124	MALS 24 Kanoehe, HI
03366	USS AMERICA (CV-66)
00188	NAS Norfolk, VA
03362	USS INDEPENDENCE (CV-62)
62758	SRF Yokosuka, JA
60200	NAS Cecil Field, Jacksonville, FL
65886	NADEP, NAS Jacksonville, FL
09112	MALS 12
09111	MALS 11
65923	Marine Aviation Depot, Cherry Pt, NC
21297	USS ABRAHAM LINCOLN (CVN-72)
03359	USS FORRESTAL (CV-59)
09116	MALS 16(Rear), 3rd MAW, MCAS Tustin, CA
62876	NAS Cubic, Point, RP
00383	ASO Philadelphia, PA
09808	MALS 39 Camp Pendleton, CA
65889	NADEP NAS Pensacola, FL
03369	USS DWIGHT D. EISENHOWER (CVN-69)
03363	USS KITTY HAWK (CV-63)
60191	NAS Oceana, Virginia Beach, VA
03360	USS SARATOGA (CV-60)
00620	NAS Whibey Island, WA
61577	NAS Guam, MI
62995	NAS Sigonella, IT
48758	NAPRAPRO, Atsugi, JA
09131	MALS 31 Beaufort, SC

NADEP North Island is DDDC's most prolific IPG I requisitioner. Its primary mission is to perform depot level maintenance on aircraft airframes, avionics, engines, and other systems. As with DDOC, a significant portion of

NADEP's workload is to recondition DLRs. Further aviation maintenance units contributing to the high proportion of San Diego's IPG I customer base include NASs and MALSs.

Just as Mare Island NSY is to Oakland, Long Beach NSY is to San Diego in generating the second highest number of IPG I requisitions. Long Beach NSY is the Navy's only West Coast non-nuclear qualified shipyard. Its primary mission is to overhaul surface combatants.

Long Beach NSY is, however, only one of several non-aviation industrial activities that are major San Diego IPG I requisitioning constituencies. These constituencies include other NSYs such as Mare Island, Bremerton, and Pearl Harbor; SRFs, and SIMAs. Again, these units use IPG I to prevent work stoppage. Finally, as in Oakland, forward positioned activities often perform emergent voyage repairs on deployed ships. IPG I requisitioning is often required to complete these repairs in a timely manner to allow the ship to meet operational commitments.

Southern California is the homeport to over one hundred and thirty ships of all types including three aircraft carriers, twelve cruisers, fifteen nuclear-powered submarines, and various logistics support ships. Unlike Oakland, which has a relatively small number of afloat units, San Diego has the largest concentration of Naval ships in the Pacific Fleet. These operational units constitute the largest, but not the most prolific, IPG I constituency

discussed. The commands to which these ships are assigned must maintain full mission capability at all times. Therefore, as in the case with the ships homeported in the Oakland area, they may requisition using IPG I to restore mission debilitating equipment casualties and to meet operational commitments. These ships are also authorized to use higher requisitioning priorities within IPG I than industrial activities.

3. Sharpe

a. History

In 1942, the Sharpe site was officially dedicated as the Lathrop Holding and Reconsignment Point. What was once a central California sheep ranch was transformed into a major military supply installation capable of loading 6,000 rail cars per month with supplies and equipment at its wartime peak. Often up to 450 rail cars were loaded or unloaded within 24 hours.

Following World War II, the depot underwent administrative changes as supply missions changed and assumed a new name in 1948. The depot was named Sharpe General Depot in honor of Maj. Gen. Henry G. Sharpe, Quartermaster General of the Army from 1905 to 1918.

The lull after World War II was terminated by the Korean War. Sharpe's level of activity rebounded to its earlier high

as manpower, shipments, and missions doubled during this three-year effort.

Supply operations were gradually curtailed when the Korean War ended and, by 1959, significant changes affecting Sharpe's future role were taking place. DoD instituted the "Single Manager Concept." This put the depot into the business of providing medical supplies and subsistence on a large scale for its sister services.

The Sharpe site became Sharpe Army Depot in 1962 when the depot was assigned to the Army Supply and Maintenance Command. In 1965, the nation again called upon Sharpe to support the Vietnam War. Hundreds of Army aircraft, both fixed-wing and helicopters, were arriving at Sharpe to get ready for shipment overseas. Twenty-four hour operations began and Sharpe became the major pipeline for supplies moving westward to Southeast Asia.

Sharpe eventually became the Army's supermarket as items such as amphibious watercraft, helicopters, generators, jeeps, trucks, bridgebuilding equipment, nuts, bolts, screws, and insect repellent were among the hundreds of thousands of items in the Sharpe inventory.

In 1985, construction began on an ultra-modern warehouse facility at Sharpe as part of the Army's Area of Operational Responsibility (AOR) regional supply depot program. This facility's features include high-rise storage racks with man-riders similar to, but on a greater scale, than the system in

Oakland. Additional features include receiving assist devices including bar code readers and on-line terminals at receiving/inspection stations, storage and shipping stations with bar code readers, and an automated guided vehicle system. The facility was completed in 1991, with computer links to DDRW headquarters in Tracy achieved during October of 1992.

b. Customer Base

The top one hundred Sharpe IPG I requisitioning activities reflect a wider variety of services than either Oakland or San Diego (Appendix C). Over ninety-five percent of the two latter activities top IPG I customers were either Navy or Marine Corps. Understandably, however, seventy-five percent of Sharpe's IPG I requisitions were submitted by Army activities. The remaining twenty-five percent reflect requisitions submitted by the other three services; the majority being from the Marine Corps and Air Force (Table IV). In fact, Sharpe's most prolific IPG I customer is the Marine Corps Logistics Center at Barstow, California.

Table IV. Sharpe Customer Base By Service.

Sharpe Customer Base by Service			
Service	# of Activities	#IPG I Reqns	% of Total
Army	75	22,926	72.7
Marines	8	4,370	13.8
Air Force	16	4,066	12.9
Navy	1	189	0.6
Totals	100	31,551	100.0

A major point of interest in examining Sharpe's customer base is the existence of an ad hoc two-tiered support system within Army activities. It is possible, in extreme circumstances, for an isolated operational unit to submit requisitions, including IPG Is, directly to its designated regional depot. The more common procedure is for the requisitions to be accepted by either a direct or general support unit which will, in turn, process them to the higher level (depot). In cases where no support units are co-located with the requisitioner in question, requisitions are submitted to the installation activity (either logistics or industrial operations) who, in turn, transmits it to the next higher level. It is important to note that these installation activities have no endemic support relationship to operational units and perform these services solely upon special arrangements agreed upon between the supported unit and the installation commander.

III. ALTERNATIVES

There are many reasons, both favorable and unfavorable, for a customer to requisition using IPG I. This chapter will discuss why customers use IPG I and suggest three alternatives that DLA could consider to curb IPG I abuse. The advantages and disadvantages of these alternatives are also discussed.

A. CUSTOMER REASONS FOR REQUISITIONING USING IPG I

As discussed in the last chapter, IPG I is designed to expedite urgent material requirements. For operational units, urgency corresponds to repair of critical equipment, the loss of which seriously impairs the unit's ability to carry out its mission. Therefore, operational unit urgent requirements are well defined and IPG I abuse is relatively easy to uncover. In addition, these units are subject to Supply Management Assessments (SMA) by their immediate superior once every eighteen months and violations of UMMIPS standards are considered major inspection discrepancies (NAVSUP P-485).

For industrial units, urgency equates to work stoppages which potentially can create significant additional costs in lost labor hours and slipped production schedules. UMMIPS standards are very specific for industrial activities. They authorize use of IPG I only to eliminate existing work stoppages. In practice, to some industrial activities'

material managers, this policy is equivalent to "closing the barn door after the horse has run out" (Wilcoxen '92). As a result, some industrial activities may use IPG I proactively, in violation of UMMIPS guidelines, to requisition materials necessary to prevent predicted work stoppages.

This proactive practice not only contributes to priority abuse, but industrial material managers often rationalize their definition of impending work stoppage to the point where IPG I responsiveness becomes the expected norm. This may lead to lower priorities becoming unacceptable for even routine requirements as industrial activities attempt to minimize ordering lead times.

Repair turn-around time reductions have been institutionalized at industrial activities in response to policies imposed upon them by their superiors. For example, Naval Air Systems Command's (NAVAIR) "open and inspect" policy for NADEP repair of Depot Level Repairables (DLR) states that the time standard a NADEP is required to meet in returning components to operational condition is applied to the time interval in the NADEP which begins when the component is first opened and inspected to determine repair requirements (Wilcoxen '92). This policy forces limits on both material ordering lead times and tolerance for variation in lead times (the shorter the lead time, the smaller the variation in lead time performance).

In addition, the costs of carrying inventories contribute to industrial activities' overhead expenses. In the past, these carrying costs were accepted as being the less expensive alternative when compared with not having critical materials available when needed. In other words, carrying inventories was a preventive strategy used by these activities to avoid stockouts and the associated work stoppages. This strategy is now prohibitively expensive as shipyards and aviation depots come under increasing pressure to reduce overhead costs and follow the Defense Base Operating Fund (DBOF) guidelines that encourage competition with private commercial activities.

As a consequence, both government and commercial repair activities are now turning to Just-In-Time (JIT) management techniques to reduce turn-around times and inventory carrying costs. For government activities, these techniques also encourage increased use of IPG I requisitioning. As long as shipyards and aviation depots are not penalized by paying increased prices for use of IPG I, cost minimization, competitive pressures, and JIT dictate IPG I requisitioning.

Finally, the lack of rigorous audits by their superiors of industrial activities' UMMIPS performance contributes to this perception of IPG I's purpose. For example, based on one author's experience, non-nuclear shipyard material operations are subject to a cursory tri-annual NAVSEA audit. This audit is normally completed in one week or less and findings are not subject to the same scrutiny as in operational units.

B. ALTERNATIVES AVAILABLE TO CURB IPG I ABUSE

UMMIPS policy already places restrictions on the use of IPG I through the FAD and priority systems. These constraints are compounded by upper limit restrictions on amounts of IPG I and II requisitions each activity type may submit (OPNAVINST 4614.1F). For example, no more than, eighty percent of all requisitions submitted by a submarine may be IPG I or II. Aviation depots and shipyards are similarly limited to an IPG I and II ceiling of no more than fifty percent of all requisitions submitted. DLA already has the capability tc generate reports by UIC that list, by IPG, total amounts of requisitions submitted (Green '92). DLA could aggressively enforce the UMMIPS ceilings, or set their own IPG I limits. To deal with activities exceeding these ceilings DLA could: (1) refuse to process these additional IPG I requisitions; (2) automatically downgrade any additional requisitions to IPG II or III; and (3) impose penalty costs in the form of surcharges on all IPG Is.

The first alternative of simply refusing to process IPG I requisitions over a set limit is not reasonable. DLA's primary mission is to support their customers. Flat refusal to process these requisitions is inconsistent with this mission. Therefore, automatic downgrading of or applying penalty costs to IPG I requisitions is much more practical.

Current DLA practice is to reduce to IPG III any IPG I requisition that does not cite certain Required Delivery Dates

(RDD) and project codes (Corbett '92). The advantage of this type of policy is that customer requisitions would continue to remain valid in the supply system but their lead times would increase in accordance with the lower priority standards. This automatic downgrade policy was established to insure illicit IPG I requisitions were filtered out and not expedited. DLA could broaden this concept to expand the number and types of IPG I requisitions subject to automatic downgrading.

By adapting this restrictive policy, DLA could also predict their IPG I workload and plan accordingly. DLA could even determine their desired workload requirements first, and then set their ceilings to insure this desired workload is not exceeded. Unfortunately, this policy is relatively insensitive to real world shifts in customer needs and, therefore, should be carefully monitored by DLA.

The final alternative suggested would be to impose a penalty cost, in the form of a surcharge, on all IPG I requisitions. One advantage of using surcharges as a method to control IPG I abuse is they can be tailored precisely to the customer. As described above, use of IPG I by operational units is tightly restricted by policy. These restrictions are then enforced through rigorous inspection and reporting procedures. Therefore, these units' IPG I requisitions are likely to be legitimate and they should not, under any circumstance, be required to pay IPG I surcharges.

Other units, including industrial activities, not subject to rigid oversight could be levied a surcharge by DLA for their use of IPG I.

Surcharges also have the advantage of leaving the ultimate decision up to the customer as they would be required to evaluate if IPG I responsiveness is worth the additional cost (surcharge) they must pay. In other words, market forces would determine the value of responsiveness to each customer if they must pay a premium price for that responsiveness.

Upon intuitive evaluation of the above alternatives, CDR Corbett felt that the concept of surcharge imposition may be the preferable method for curbing customer abuse of and reducing DLA's costs associated with IPG I requisitions (Corbett '91). This reasoning, reinforced by cursory evidence available at the time, lead to his request for further research on the potential for development of a surcharge effects model by the students at NPS.

IV. MODEL EVOLUTION

A. BACKGROUND

1. Previous Models

a. Material Logistics (MN3372) Course Project

The first feasibility test of this thesis topic was as a research paper for The Naval Postgraduate School's (NPS) Material Logistics course (MN3372) (Halkias & Miller '92). Halkias and Miller developed a model for emulating the Shipboard Uniform Automated Data Processing System (SUADPS) Demand Based Item (DBI) procedures for consumables at mechanized consumer or intermediate level activities (NAVSUP P-553).

The first part of the model consisted of the inequalities used to decide when to stock or retain an item in stock. The rules are that an item will be stocked if annual demand is greater than two units per year. Items will be retained in stock if there was at least one unit of yearly demand.

Once an item meets these stockage thresholds, the SUADPS-DBI mechanism establishes a reorder point and requisitioning objective. The reorder point is created by adding a predetermined safety level to the number of units required to meet the average demand during an order and shipping time specified by OPNAVINST 4614.1F. The requisitioning objective

is determined by adding an operating level to this reorder point. The operating level, or order quantity, is based on the average monthly demand, item unit price, ordering costs, and inventory holding costs (Equations 1 and 2).

$$ROP=(SLF*AMD)+(OSTF*AMD) \tag{1}$$

$$RO=ROP+\sqrt{24A/H}\sqrt{AMD/UP} \tag{2}$$

where

ROP = Reorder Point (Low Limit);

RO = Requisition Objective (High Limit);

SLF = Safety Level Factor;

AMD = Average Monthly Demand;

OSTF = Order & Ship Time Factor;

A = Ordering Cost;

H = Holding Cost Rate; and

UP = Unit Price

To test surcharge effects on this model, a flat rate surcharge variable was added to the ordering cost and/or the unit price was increased by the percentage surcharge. The Safety Level Factor (SLF) was also adjusted separately from six months to three months to ascertain its effects on the model when altering surcharges. A fictional data base was developed in the MN3372 project to perform a sensitivity analysis of these two types of surcharges alone and in

combination. The model and fictional sample data base were written into a "Lotus 1-2-3" spreadsheet application.

Sensitivity analyses were conducted by altering unit prices using a range of percentage surcharges to assess the effects of those surcharges on ordering decisions. Flat rate surcharges also were tested by progressively increasing the administrative order cost portion of the model. Both types of surcharges were set at a variety of levels both individually and in combination. Total dollar values and number of items stocked in inventory were recorded at each level. Customer response was displayed by plotting the changes in inventory levels and dollar values as percentage and flat rate IPG I surcharges were imposed.

Graphs of the results of these analyses were examined for trends (Figures 1 through 6). These trends are a result of the changes mentioned above. This simple model revealed fundamental phenomenons that have continued to hold true as both models and databases evolved in their complexity. First, even a modest percentage of unit price as a surcharge can rapidly affect both the level (number of items carried) and total value, which includes the surcharge, of inventory carried (see Figures 1 and 4). Review of the fictional data base revealed this was especially true for more expensive items.

Next, requisition flat rate surcharges exerted a strong influence on the inventory depth of customer-stocked items as

a consequence of the customer attempting to reduce the number of requisitions submitted. Inspite of that, the value of the inventory does not increase very much (see Figures 2 and 5).

Review of the fictional data base disclosed flat rate surcharges tend to be more effective for lower priced items with few demands because the flat rate drives up total requisition cost independent of unit price. In combination, flat rates were quickly overshadowed by even modest percentage surcharges. Finally, when the Safety Level Factor (SLF) was reduced to three months levels, the number of items stocked and the dollar values of inventory carried dropped significantly (compare Figures 1, 2, and 3 with Figures 4, 5, and 6).

Unfortunately, the SUADPS-DBI decision process was not suitable for this thesis. In that process stock range decisions are based on the yearly quantity demanded exceeding two and then one to retain. Unit costs are not considered in making this part of the decision. Therefore, surcharges would not be a factor in deciding stock.

An additional shortcoming of the SUADPS-DBI decision process was its inability to deal with the effects of surcharges on items not brought into stock due to an annual demand of less than two units. Surcharges could conceivably justify stocking a small quantity of these items as the least cost alternative. This could occur if surcharge policies were structured in a manner sufficient to penalize even low

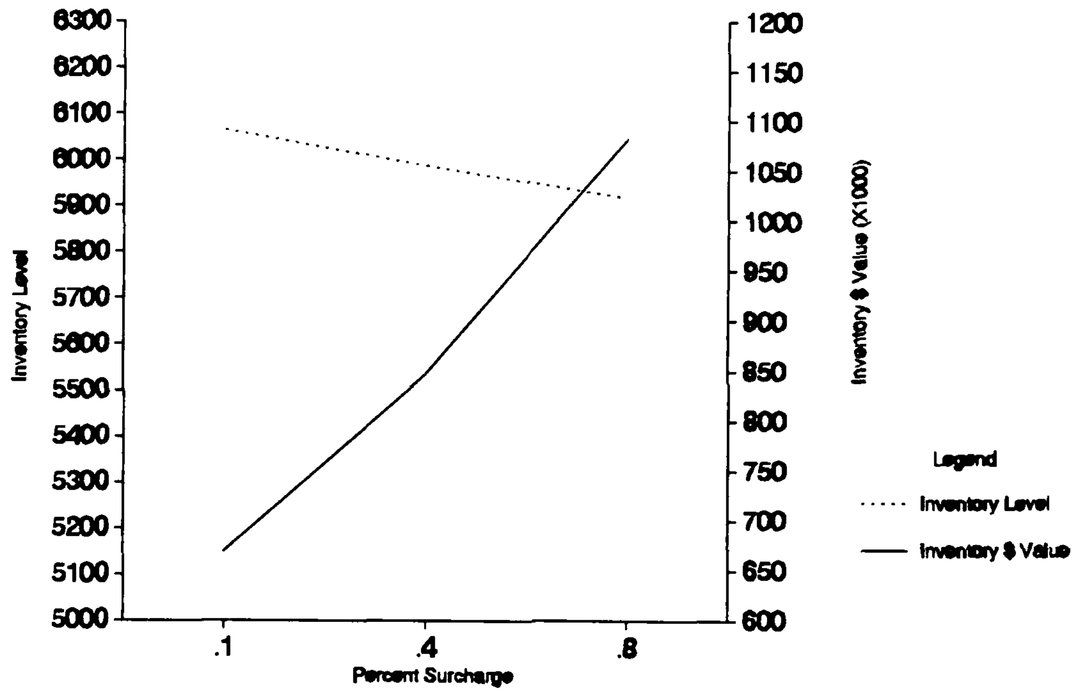

Figure 1. Percent Surcharge Only; Safety Level and Order & Ship Time = 6 months

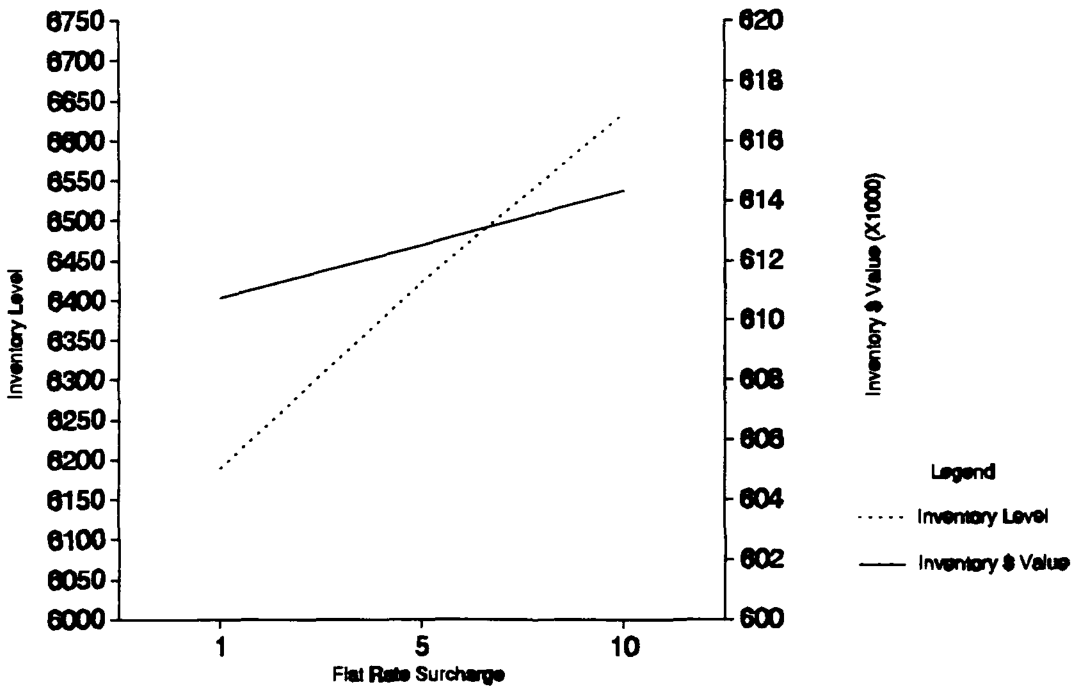

Figure 2. Flat Rate Surcharge Only; Safety Level and Order & Ship Time = 6 months

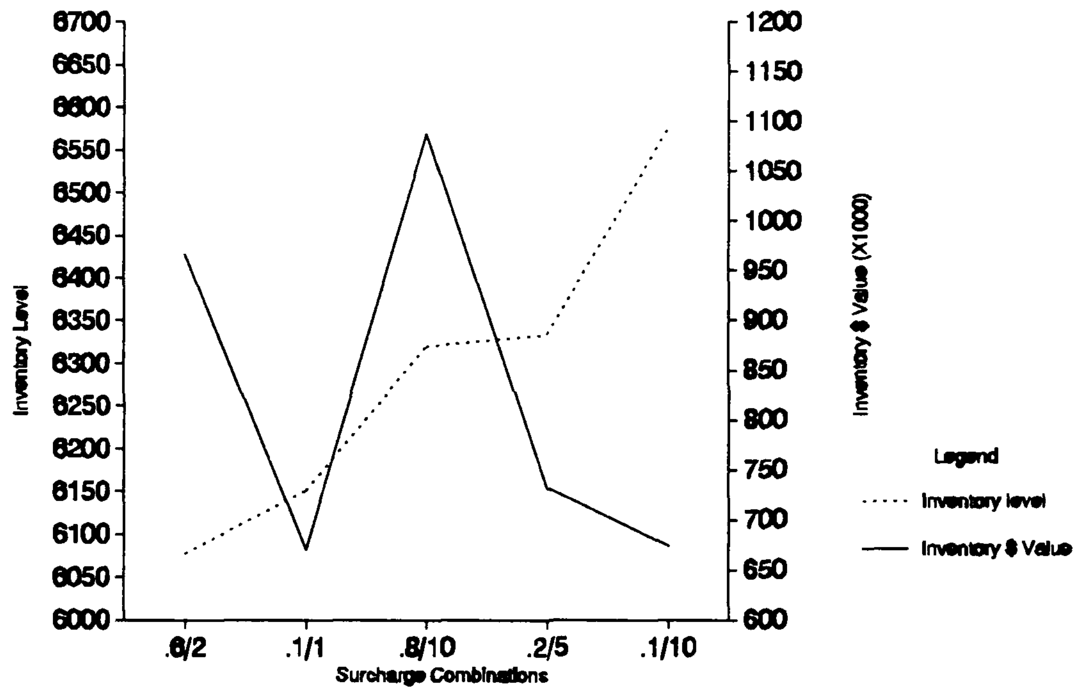

Figure 3. Percent/Flat Rate Surcharge Combinations; Safety Level and Order & Ship Time = 6 months

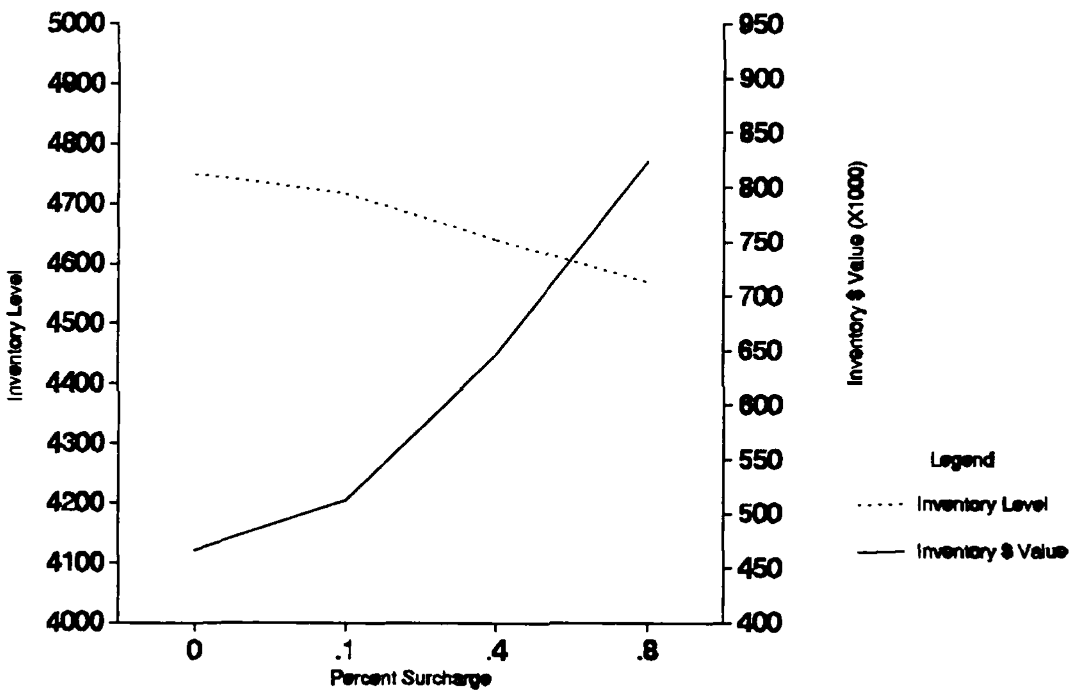

Figure 4. Percent Surcharge Only; Safety Level = 3 months, Order & Ship Time = 6 months

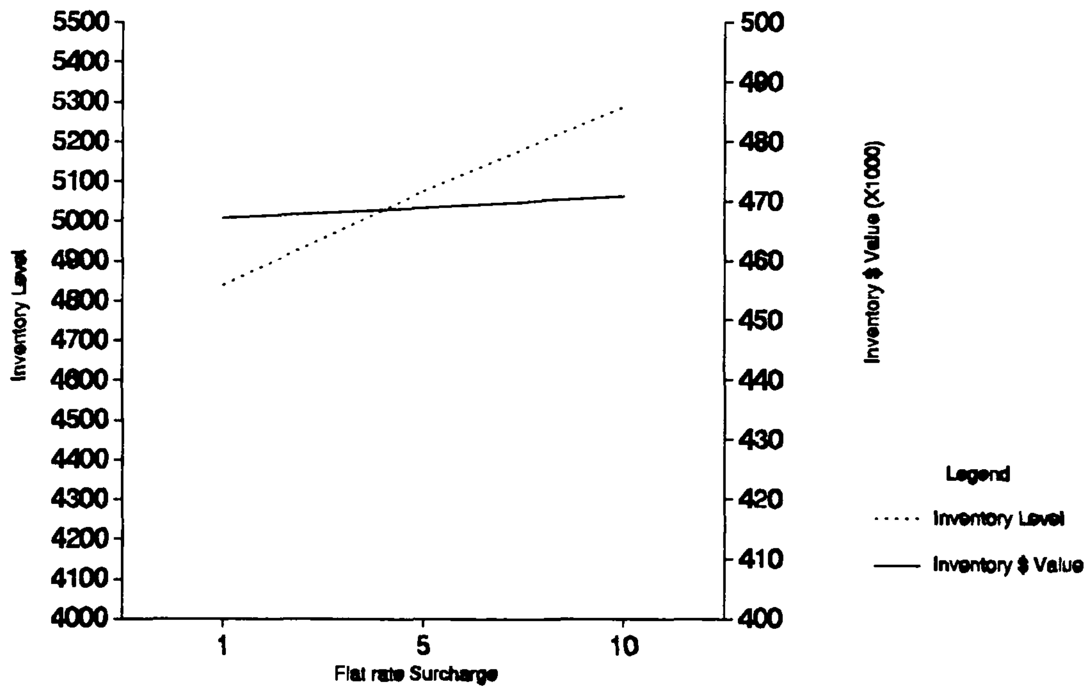

Figure 5. Flat Rate Surcharge Only; Safety Level = 3 months, Order & Ship Time = 6 months

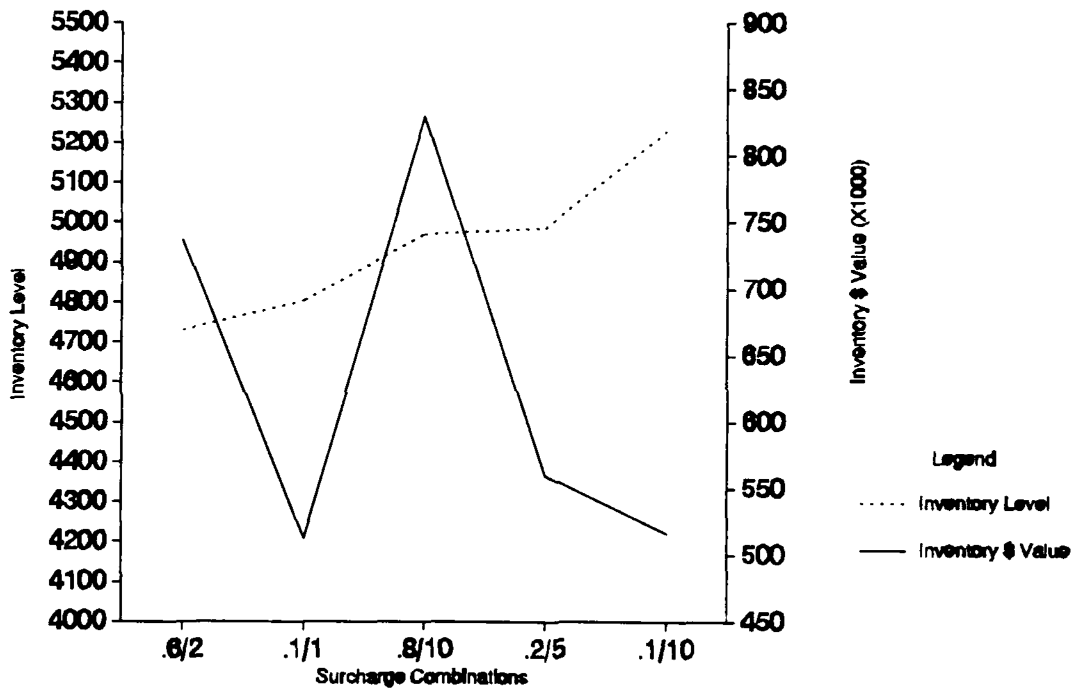

Figure 6. Percent/Flat Rate Surcharge Combinations; Safety Level = 3 months, Order & Ship Time = 6 months

frequency orders of one or less unit per year.

The final shortcoming is the lack of cost elements in the reorder point calculation. Surcharges would increase the cost of issuing IPG I requisitions to fill stockout demands. Therefore, to avoid paying these higher costs, the safety level portion of the reorder point equation would be expected to increase as IPG I surcharges were imposed. The SUADPS-DBI process contains a predetermined "Safety Level Factor" determined by Naval Sea Systems Command (NAVSEA), or Naval Air Systems Command (NAVAIR); it does not include a direct method to ascertain the effects of surcharges on safety stocks.

b. Logistics Engineering (MN4310) Course Project

The MN3372 project theme was further refined by follow-on research conducted for NPS's Logistics Engineering course (MN4310) (Ebert, Halkias, Miller, Parker '92). DDOC provided the Unit Identification Codes (UICs) and the total numbers of IPG I requisitions submitted by their top fifty customers over a nine-month period from June 1991 through March 1992.

Analysis of this data revealed that a high proportion of customers were industrial activities. In particular, Naval Aviation Depot (NADEP) Alameda submitted roughly forty percent of DDOC's IPG I requisitions. NADEP Alameda's primary mission is to perform depot level aircraft maintenance. Naval Air Stations (NAS) accounted for an additional twenty-nine percent

of all demands. These air stations submitted their requirements to support intermediate level maintenance actions. When Naval Shipyards and other ship repair facilities were included, industrial activities accounted for approximately eighty-five percent of DDOC's IPG I customer requisitions.

Industrial activities present unique difficulties for inventory modelers. These activities order materials to complete specific actions referred to as jobs. With the exception of generic consumable materials, these activities do not normally maintain inventories to sustain fleet readiness.

This research paper attempted to duplicate the decision logic a material manager might exercise in deciding whether to continue IPG I requisitioning as urgent needs arose or maintain limited inventories. A "Lotus 1-2-3" spreadsheet application was used to address the tradeoff between ordering as requirements occurred with an IPG I surcharge and maintaining an inventory and ordering without a surcharge based on EOQ reorder point calculations. As DDOC provided only UICs and their total numbers of IPG I requisitions, an accompanying "fictional" individual requisition data base was created to facilitate the tradeoff analysis.

The annual costs to order with a surcharge were calculated by multiplying the annual quantity of an item demanded by the surcharge-adjusted unit price for that item.

This adjustment was accomplished by multiplying the unit price by one plus the decimal fraction (associated with the percent) for the percent surcharge, then adding the flat rate surcharge to this total. The annual quantity demanded was then multiplied by the original unit price and was subtracted from the adjusted annual costs to provide only the total annual costs associated with the surcharges.

Determining the costs to stock without a surcharge was a more complex process. Prior to EOQ computations, the fictitious data base was examined for multiple requisitions for identical items. These multiple requisitions were included in the fictitious data base to test EOQ reordering frequencies vice IPG I requisitioning as individual demands occurred (unless EOQ is equal to one unit, fewer requisitions would be generated using an EOQ model than would be if a requisition was submitted for each unit demanded). Multiple requisitions for identical items were totalled by quantity ordered at the bottom of the spreadsheet in order to simulate annual demand. This sum was used to calculate EOQ for the item. The EOQ was also calculated for unique single requisitions; in these cases, quantity ordered was assumed to be annual demand.

These EOQs were then used in the average annual total variable cost equation to determine the annual total variable costs to order and carry in stock. Both total cost to stock and total cost to order were based on the total cost equation

used to derive the deterministic EOQ without backorders (Tersine '88).

Surcharges were not applied in determining stockage costs as the assumption was made that inventory reorders would be made using routine priorities as required by the calculated reorder point.

The model was also designed with a variable lead time option to allow exclusion from high priority requisitions those items which, under routine ordering priorities, would possess acceptable lead times.

The decision to place an item in stock or order with IPG I was made by comparing surcharge and total annual variable costs. The minimum cost determined by this comparison was added to a running total maintained for each category on the spreadsheet.

As in the MN3372 paper, flat rates and percentages were incorporated into the order costs and unit prices, respectively, when surcharges were applied. The program facilitated sensitivity analyses for a wide variety of percentages and flat rate surcharges, both independently and in combinations.

Percentage surcharges alone were extremely effective for higher valued items; these items rapidly shifted to being stocked in inventory as the rates climbed (Figures 7, 8). Combinations of flat rate and percentage surcharges were addressed in Figure 9. Figure 9 appears to be very similar to

Figure 8, but actual costs are slightly higher with the addition of a flat rate of eight dollars per requisition.

Figure 7 disclosed some interesting traits. To simulate materials carried in Oakland's inventory, several items in the fictional data base were created with a response time under routine ordering priorities of five days. In other words, using normal priorities the customer would have material within five days of submitting a routine requisition. Therefore, if the customer was willing to accept a lead time of five days, these items would be neither ordered using IPG I, nor stocked in customer inventories. Instead, these items would continue to be ordered as needed using routine priorities. In Figure 7 the customer is willing to wait five days and, as a result, the total cost to order line does not decrease to zero with the increased application of percent surcharges. In Figure 8, the customer is only willing to accept a lead time of four days and, therefore, all items are subject to percent surcharges. Under these circumstances, the total cost to order line decreases to zero as these surcharges are increased and all items are eventually stocked.

As percent surcharges were applied the total cost to stock rose as the number of items brought into inventory increased in steady increments. Between six and nine percent cost to order continued to rise while cost to stock remained level. A possible explanation for this phenomenon is that although

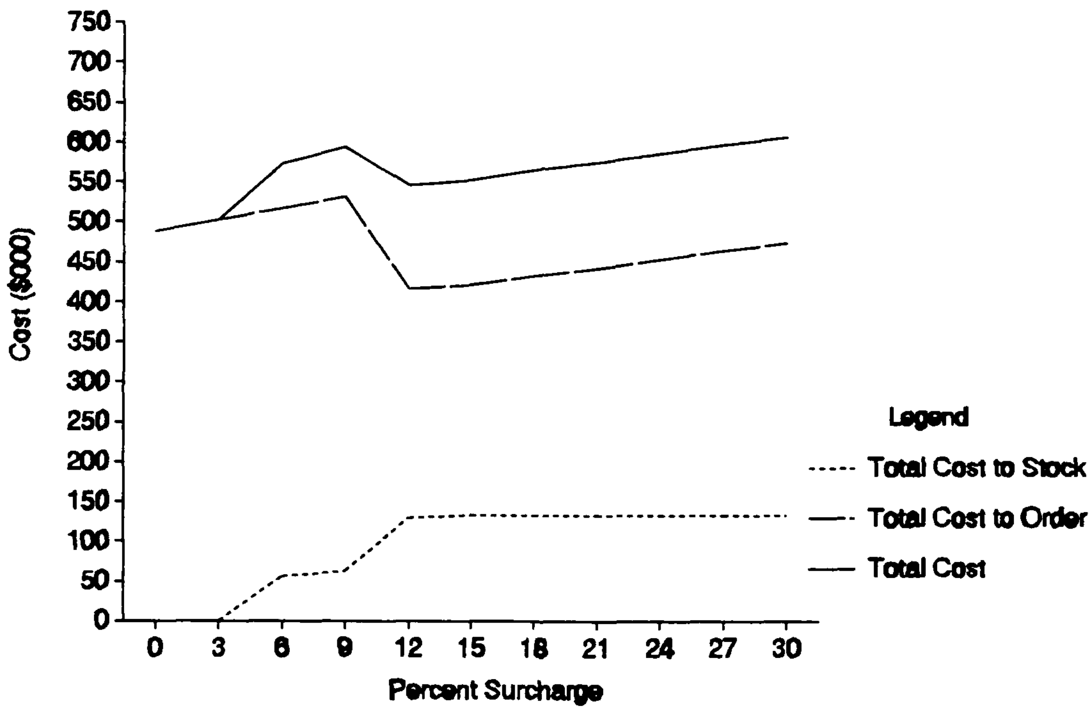

Figure 7. Percent surcharge only, Lead Time = 5 days, Order Cost = $20, Holding Cost Rate = 23%

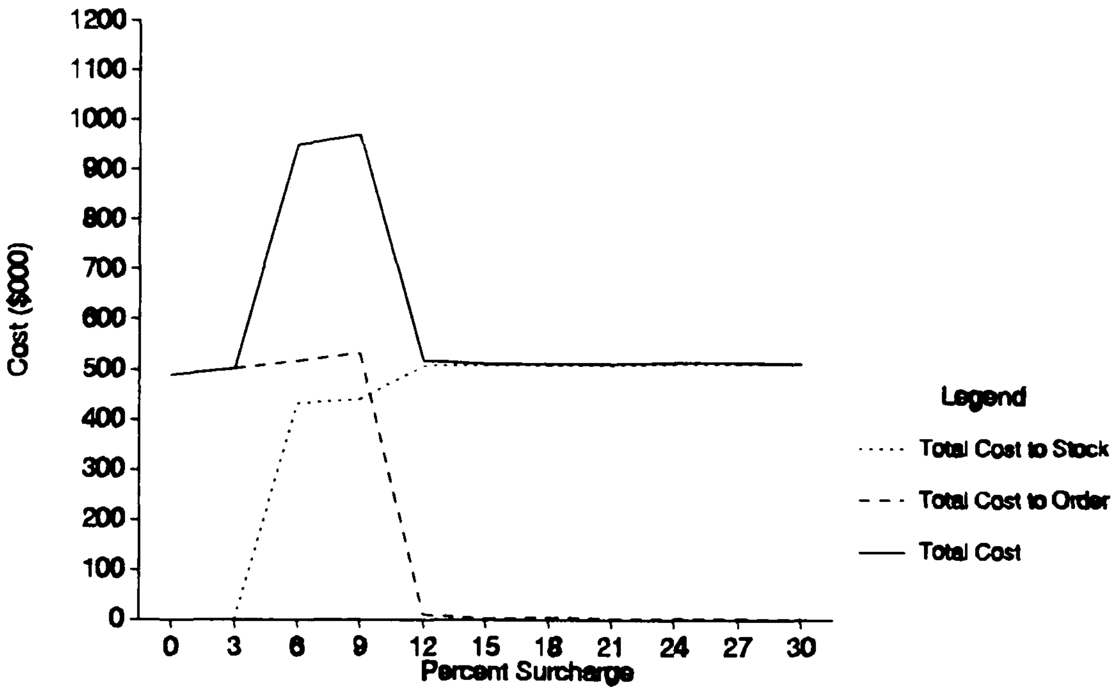

Figure 8. Percent surcharge only, Lead Time = 4 days, Order Cost = $20, Holding Cost Rate = 23%

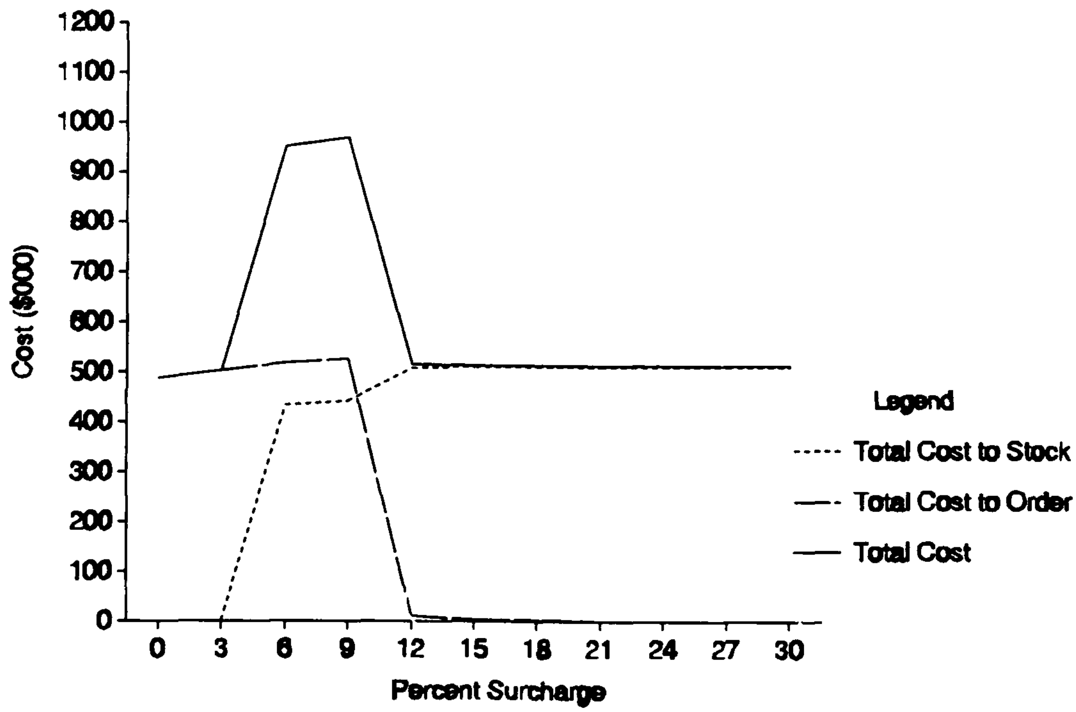

Figure 9. Percent and Flat Rate Surcharge, Lead Time = 4 days, Order Cost = $20, Holding Cost Rate = 23%, Flat Rate = $8

this percentage range increased the cost to order, it did not increase this cost enough to force additional items into stock. As a result, the cost to stock did not increase. By the time the percent surcharges had risen to twelve percent, only very low valued items, and items meeting the response time requirement of five days without using IPG I, continued to be ordered.

In Figures 8 and 9, the lead time requirement was reduced to four days. No items in the data base created met this four day threshold and, as a result, all were subject to the order using IPG I versus stock in inventory decision. As shown in Figure 8, the cost to stock rose steeply between three and six percent as most items were brought into inventory. From six through twelve percent the cost to stock rose gradually as the remaining items migrated into customer stocks. Another noteworthy event between two and twelve percents is the sharp peak in total costs as surcharges are paid for items that continue to be ordered while cost to stock rise as more items are brought into customer inventories. After twelve percent all items, regardless of cost, were stocked and none were ordered. As a result, the total cost to order line decreased to zero and both the total cost and cost to stock stabilized at approximately half a million dollars.

Although not shown, flat rate surcharges were initially significant for low dollar value items even at relatively

modest values. However, after this initial impact and the migration of low unit price items into stock, even extremely large flat rates surcharges (levels of up to five hundred dollars per transaction were tested) appeared to be ineffective.

The MN4310 research provided the first quantitative evidence of the intuitive hypothesis that a combination of flat rate and percentage surcharges was the most effective method of reducing total IPG I requisitions (Figure 9). As in the MN3372 paper, the effects of the percentage surcharge quickly dominated flat rates.

B. THESIS MODEL DESCRIPTION

1. Model Requirements

To fulfill CDR Corbett's proposal requirements, actual IPG I requisitioning data from several types of activities and more sophisticated modelling techniques were essential. Although the MN3372 and MN4310 projects were useful for understanding surcharge effects, both models were rather simplistic because of their small fictional data bases.

The model requirements for this thesis have evolved considerably since the idea was originally conceived in December of 1991. At that time, leading IPG I customers were to be classified by type of activity. A model duplicating the inventory management system used by each activity type was to have been created to test surcharge effects using actual

requisition histories as data bases. Analysis of Oakland's customer base during the MN4310 paper revealed some problems with this approach.

As described earlier, Oakland's most prolific IPG I customers are industrial activities. Industrial activities plan job-unique material orders using Material Requirements Planning (MRP), Just-In-Time (JIT), or similar management systems instead of an EOQ-based system. Considerable thought was given to duplicating these procedures as the basis for analyzing surcharges effects on these activities. Ultimately this idea was rejected for the following reasons. First, these systems were designed to minimize on-hand inventories and reduce associated warehousing costs by ordering materials to arrive just prior to use. MRP and JIT-type systems might respond to surcharge-increased IPG I requisitioning costs by reducing their stockout risk through establishing inventories or by changing priority class. This latter alternative would mean they would have to plan for longer lead times. Due to their major customers' pressure for reducing repair turn-around times, extending lead times might not be feasible for many industrial activities.

Second, MRP and JIT systems do not manage items based on total activity requirements such as annual demand. As noted above, materials are ordered according to the requirements of individual jobs. Therefore, a JIT- or MRP-

based model to test the surcharge effects would show only cost increases for the customer.

Finally, the extracts each depot provided of their demand histories were keyed on document and stock numbers. JIT-and MRP-based models would have to be based on job requirements for materials. The depot data bases, however, did not contain the information required to sort by individual job because job order numbers (JONs) were not available from the depots for the individual activities.

Stochastic models were considered because demand is really a random variable. However, the accurate lead time data was not available. Although it was possible to determine the date a requirement was placed using the Julian date contained in the requisition number, the date the customer actually received the material could only be obtained by a review of each customer's receipt records. That would require substantially more time than was available for this thesis effort.

An additional goal was to develop a generic model useful to integrate both retail and wholesale activities. To recreate various decision processes by retail activity type would have resulted in a complex model. A less complex model is expected to have greater appeal to a wider scope of users than a more sophisticated, but difficult to understand, procedure.

When all factors were considered, the best modeling alternative appeared to be a slightly more sophisticated version of the decision making process developed for the MN4310 paper. The thesis model would, therefore, be based on the EOQ model (Tersine '88) and its deterministic Total Variable Costs (TVC) when stockage occurs and the costs under the surcharge policy when items are ordered one-for-one under an IPG I priority. A simple model founded on the model described above should adequately test proposed DLA surcharge effects on retail customers. In successfully accomplishing these tests, the model would fulfill this thesis' primary goal. The simple model is sufficient because only one year's worth of demand was known for both Oakland and San Diego. In addition, the requisition history provided by Sharpe covered less than eight months and had to be extrapolated (linearly) to estimate annual demand.

2. Model Description

The EOQ equation requires data for four parameters (equation 3). Annual demand is the total quantity of an item demanded by an activity. Order cost is the cost to the ordering activity of submitting a requisition to the supply system. This order cost includes salaries and requisition processing costs incurred by the ordering office. Unit price of the item is the price charged to the customer by the supply system for the item. Unit price does not include proposed IPG

I surcharges but does include all other charges levied by DLA that are included in the unit price, regardless of requisitioning priority. Annual holding costs are calculated as a decimal fraction of the item's price (the Navy uses 0.23 for a consumable item and 0.21 for a repairable item). Holding costs include warehousing expenditures, obsolescence, pilferage, and other losses associated with maintaining a stock of an item in an activity's warehouse. The EOQ model's average annual Total Variable Costs (TVC_s) formula is given by equation 4 (Tersine '88).

$$EOQ=\sqrt{\frac{2RC}{PF}}\ ; \qquad (3)$$

$$TVC_s=\sqrt{2RCPF}\ ; \qquad (4)$$

where

EOQ = Economic Order Quantity in Units;

TVC_s = Total Variable Cost to Stock;

R = Annual Demand in Units;

C = Ordering Cost per Order;

P = Unit Price of the Item; and

F = Annual Holding Cost as a Decimal Fraction of P.

When an item is not stocked but is ordered instead as needed under IPG I, the average annual total variable costs (TVC_n) formula is given by equation 5.

where

$$TVC_c = RS_p P + N(C + S_f);\qquad (5)$$

TVC_c = Total Variable Cost to Continue IPG I ordering;

R = Annual Demand in Units;

S_p = Percentage IPG I Surcharge (given as a decimal fraction) per Unit;

P = Unit Price;

N = Number of IPG I Requisitions submitted;

C = Ordering Cost per requisition; and

S_f = Flat Rate Surcharge per IPG I order.

3. Model Parameters Values

The data provided by each depot was segregated by Unit Identification Code (UIC), and within each UIC by National Stock Number (NSN). The individual requisition quantities for identical NSNs were then totalled to provide actual IPG I annual demand quantities for each item. An additional calculation determined the number of times the same NSN appeared in different requisitions. This total was used to determine the total number of requisitions, N, submitted annually by the UIC for the item. The data also included unit prices, P, for most items.

Through Cognizance Symbols (Cogs) and Federal Supply Groups (FSG), a means was provided to determine applicable service peculiar holding cost rates for each item, F. As mentioned earlier, there are two Navy holding cost rates, 0.21 for repairables, and 0.23 for consumable items

(repairables are less likely to be pilfered or lost than consumable items) (GAO/NSIAD Report #92-112). The repairable holding cost rate was assigned to Cogs described in Table V. The 0.23 rate was used for all other Cogs.

Table V. Repairable Item Cogs.

Cog	Description
2F	Major Shipboard Electronic Equipment
3H	Ships Parts Control Center managed Fleet Level Repairables (FLR)
4Z	Airborne Armament Equipment
6K	End Items of Photographic Equipment
7E	Depot Level Repairable Ordnance Equipment Repair Parts and Air Missile Parts
7G	Depot Level Repairable Electronic Equipment
7H	Depot Level Repairable Shipboard and Base Equipment, Assemblies, Components and Repair Parts
7R	Depot Level Repairable Aviation Material
7Z	General Purpose Electronic Test Equipment
8A	Inert Nuclear Weapons Material

Sharpe's data was not associated with Cogs. Fortunately, the first two digits of an item's NSN are its Federal Supply Group (FSG). FSG categories can be associated with Army holding cost rates. For example, aircraft components and accessories are FSG 16 and were assigned the holding cost rate of 0.14 for the Army Aviation Systems Command. These rates and categories are shown in Tables VI and VII.

Order costs could be set at any desired level but, for this thesis, were fixed at twenty dollars for each UIC. Based on the authors' personal experience, twenty dollars was chosen as the value for C in the TVC formulas to reflect the

Table VI. Sharpe Inventory Control Points, Holding Cost Rates (F), and Associated FSGs.

Inventory Control Point	F	FSGs
Army Commands:		
Tank-Automotive	0.13	25,26,28,29,30
Aviation Systems	0.14	15,16
Armament, Munitions-Chemical	0.16	10,58
DLA Supply Centers:		
Industrial	0.18	31,47,48,53
Electronics	0.19	59,61
Average of all HCRs	0.17	other FSGs

Table VII. Sharpe FSG Descriptions

FSG	Title
10	Weapons
15	Aircraft & Airframe Structural Components
16	Aircraft Components & Accessories
25	Vehicular Equipment Components
26	Tires & Tubes
28	Engines, Turbines and Components
29	Engine Accessories
30	Mechanical Power Transmission Equipment
31	Bearings
47	Pipe, Tubing, Hose, & Fittings
48	Valves
53	Hardware & Abrasives
58	Communication, Detection, & Coherent Radiation Equipment
59	Electrical & Electronic Equipment Components
61	Electric Wire & Power Distribution Equipment

relatively low administrative expenses for retail activities to submit IPG I requisitions to the Navy and DLA supply systems. Unlike wholesale activities, retail units very rarely issue contracts to attain these materials. Instead, they submit their requisitions to the supply system electronically via the Defense Automated Address System (DAAS). As a result, retail order costs are much lower than

wholesale order costs which can range from $116 to $3880 depending on the size of the purchase and the inventory control point (GAO/NSIAD Report #92-112).

Finally, percentage, S_p, and flat rate, S_f, surcharges are added. Obviously, these charges can be set at any desired values. Both changes can be set to zero to represent the case of having no IPG I surcharges, or individually set to zero while allowing the other to vary to test the effects of a particular surcharge type. For example, to test an IPG I surcharge of five percent with no flat rate, the flat rate would be set to zero.

These IPG I surcharges were used only in calculating the average annual Total Variable Cost to Order (TVC_o) using IPG I when no inventories are maintained.

The TVC_o (equation 5) was calculated by multiplying the unit price of an item by the decimal fraction associated with the percentage surcharge levied to obtain a surcharge amount per unit, S_p. This surcharge per unit total was next multiplied by the annual demand for the NSN. The flat rate surcharge, S_f, was then multiplied by the number of times the item was requisitioned per year. The annual percentage and flat rate surcharge costs were then added to provide the total average annual costs to continue to order paying the IPG I surcharges.

4. Tradeoff Analysis

TVC_S and TVC_O values for each activity's NSN were compared to determine the most cost-effective choice. If TVC_S was less than TVC_O, maintaining stocks of the item was chosen as the optimal alternative and TVC_S was added to the activity's cost to stock total for other NSNs. If, however, TVC_O was less than TVC_S, continuing to order the item as required using IPG I without maintaining stocks was selected as the optimal choice and TVC_O is added to the cost to order total for other NSNs. When the two TVCs were equal, TVC_O was chosen as being the least cost alternative for the retail activity. This decision was made based on the perceived desire of most retail activities that they want to minimize their inventories due to space constraints and the desire to minimize overhead costs.

V. DATA ANALYSIS

A. DESCRIPTION OF ELEMENTS

This chapter describes methods used to examine each supply depot's data base. First, A-B-C charts comparing each depot's top IPG I order generating UICs to the cumulative total number of requisitions submitted are discussed. Second, wire diagrams (three-dimension graphs) delineating the effects of IPG I surcharges are considered. These wire diagrams were created using iterations of the thesis model described in the previous chapter. Both A-B-C charts and wire diagrams are also analyzed with an emphasis on similarities and differences between Oakland, San Diego, and Sharpe.

Wire diagrams and interval tables detailing the number of requisitions submitted per NSN were also prepared for NADEPs Alameda and North Island, and the NSYs at Mare Island and Long Beach. These activities are the top two customers for Oakland (Alameda and Mare Island) and San Diego (North Island and Long Beach) and provide the opportunity to examine the effects of IPG I surcharges on similar types of customers for these two DLA depots. Finally, interesting points discovered during this research process are described with illustrative examples.

B. A-B-C ANALYSIS

All data processing was performed on NPS's Amdahl Model 5995 mainframe computer system using SAS software. Prior to its use in analyses, each tape was audited and SAS programs were used to write data sets which were stored in the mainframe to minimize analysis run times. In the process, requisition records which were either duplicated, incomplete, or outside the year, between June 1991 and May 1992, were ignored. As requested to minimize processing time, both Oakland and San Diego provided separate tapes with IPG I requisition histories only. Sharpe was unable to sort their MRO history tapes by IPG so their tapes included all requisitioning priorities. These tapes were sorted on the NPS mainframe and an IPG I-only database was created.

A cursory initial review was performed on each valid data base as it was created. For Oakland and San Diego this evaluation was conducted using Cogs. Because Sharpe's data base did not contain Cogs, the FSG was used as a substitute. Cogs and FSGs appearing most frequently were matched with applicable holding cost rates for use in the surcharge model.

Each supply depot's data was also sorted to identify which UICs were submitting the most IPG I requisitions. Top IPG I requisitioners were then determined using Pareto's 20-80 Rule of the significant few and trivial many. This analysis revealed that the top seventy-five (Oakland and San Diego) or one hundred (Sharpe) customers constituted approximately sixty

percent of all three depots' IPG I requisitions received. Beyond these top UICs, the percentage of IPG I requisitions received from each activity decreased dramatically. Top UICs for each supply depot were matched with their official titles, listed in descending order of requisitioning frequency, and are included in Appendices A, B, and C.

These UIC lists also contained all information required to create A-B-C curves to compare each supply depot. Figures 11, 12, and 13 show these curves. San Diego's curve has the steepest initial slope of the three (Figure 11), Oakland's was second (Figure 12), and Sharpe's was third (Figure 13). This is a consequence of San Diego having the heaviest concentration of local aviation and industrial units of the three (see the top 10 in Tables VIII, IX, and X).

Although Oakland's final IPG I data base was the largest of the three with over 43,000 requisitions distributed among the top seventy five UICs, review of Oakland's UICs indicates it was less steep than San Diego because of the fairly uniform distribution of aviation and industrial units throughout the requisition frequency rankings.

Sharpe's data base was the smallest of the three supply activities studied. Because the number of requisitions submitted (from most to least prolific IPG I customer) tended to be more uniform and small, inclusion of one hundred UICs was required in order to achieve a data base with at least sixty percent of the total IPG I orders received by the depot

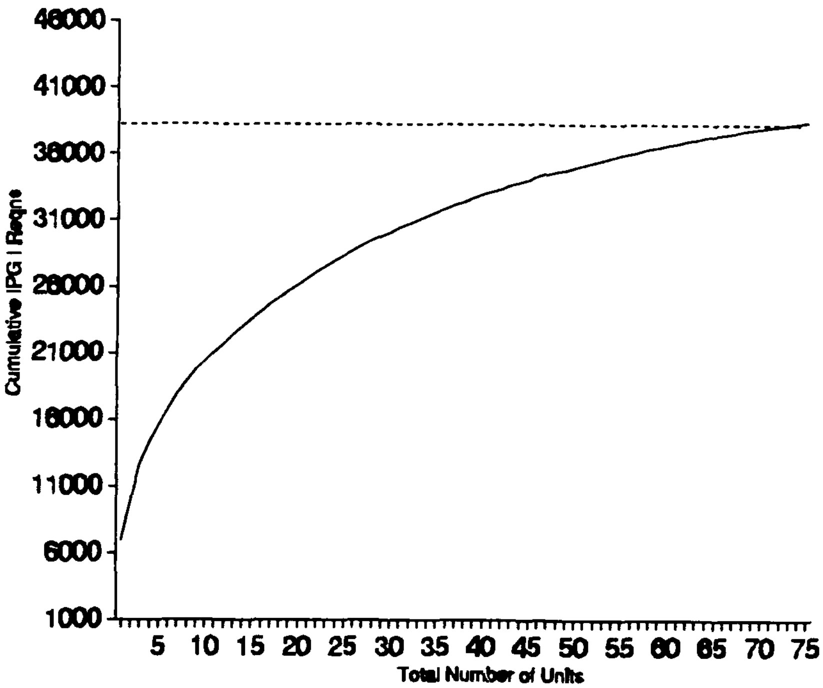

Figure 10. ABC Chart of San Diego's Top 75 Activities (Total Requisitions were 38,415).

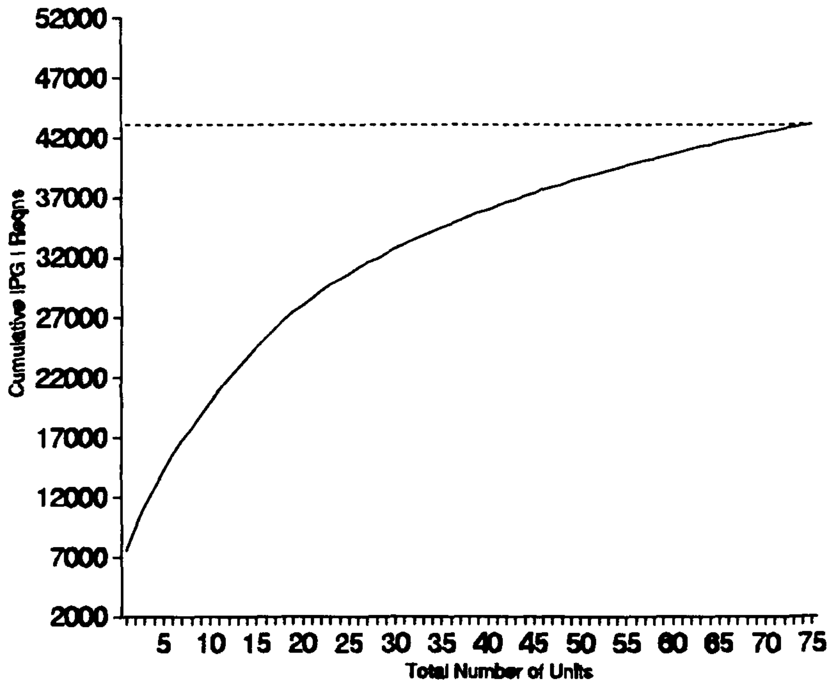

Figure 11. ABC Chart of Oakland's Top 75 Activities (Total Requisitions were 43,009).

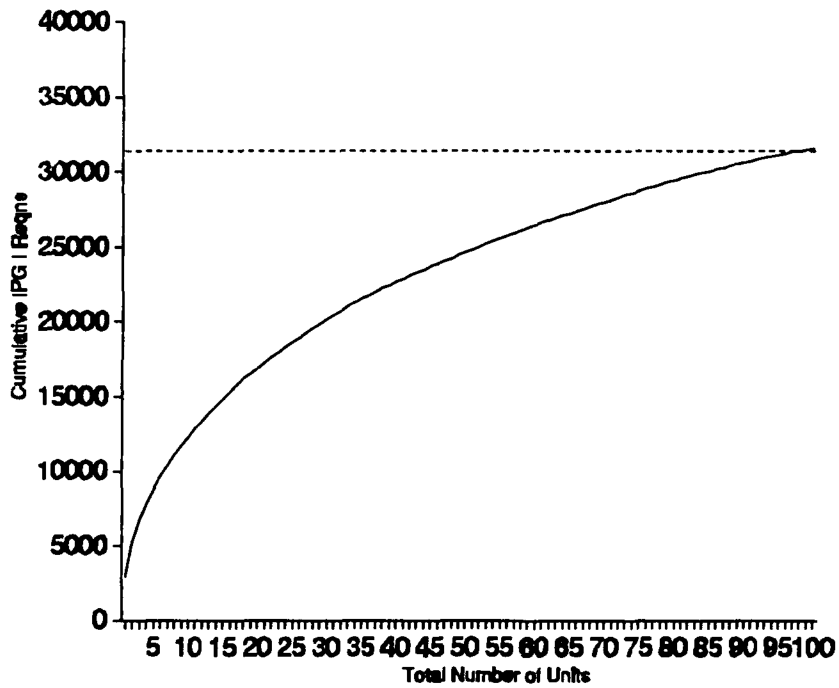

Figure 12. ABC Chart of Sharpe's Top 100 Activities (Total Requisitions were 31,551).

Table VIII. Top & Bottom 10 Activities of the San Diego Top 75 Activities.

Top Ten Units	Bottom Ten Units
1) NADEP North Island	66) USS NIMITZ(CVN-68)
2) Long Beach NSY	67) Subase, Pearl Harbor
3) NAS Miramar	68) USS PRINCETON(CG-59)
4) NAS North Island	69) MCAF Quantico
5) PMTC Point Mugu	70) SRF Guam
6) NAS Lemoore	71) USS ELLIOT(DD-967)
7) MALS 24	72) USS BUNKER HILL(CG-52)
8) USS AMERICA(CV-66)	73) SIMA Norfolk
9) NAS Norfolk	74) NAS Mayport
10) USS INDEPENDENCE(CV-62)	75) Norfolk NSY

Note: Complete names may be found in Appendix c

Table IX. Top & Bottom 10 Activities of the Oakland Top 75 Activities.

Top Ten Units	Bottom 10 Units
1) NADEP Alameda	66) USS MIDWAY(CV-41)
2) Mare Island NSY	67) USS NIMITZ(CVN-68)
3) NAS Moffett Field	68) USS DIXON (AS-37)
4) Pearl Harbor NSY	69) NAF Atsugi
5) NAS Barbers Point	70) USS SARATOGA(CV-60)
6) SRF Yokosuka	71) MALS 14
7) SIMA Pearl Harbor	72) NAS Willow Grove
8) NAPRAP Atsugi	73) Army Troop Aviation Systems Command
9) NAS North Island	74) MALS 16 (Rear)
10) Puget Sound NSY	75) USS OKINAWA (LPH-3)

Note: Complete names may be found in Appendix B

during the nine-month period of the data.

Sharpe's customers are also very different from either Oakland's or San Diego's. Although the number one IPG I ordering activity is the Marine Corps Logistic Depot at Barstow, the top customers are dominated by Army installation property and maintenance activities, which more often than not

are civilian run operations. These organizations are responsible for property accountability and maintenance support of Army activities; they are similar to Naval Station public works departments and are not active combat units. With the exception of some Air Force, a few more Marine, and one Navy activity, this pattern remains consistent through the rest of the units included in the Sharpe data base. It is interesting to note, however, that the majority of operational Army combat service support (CSS) units, both active and reserve, are in the lower half of the list. Indeed, five of the bottom ten listed in Table X are such units, in stark contrast to the top ten units listed in which only one appears.

Based on the Army author's experience, a possible explanation is that most Army CSS units (which order the bulk of requisitions in support of combat forces) are normally assigned lower Authorized Levels of Operation (ALO) than their respective combat counterparts. This, in particular, is almost always true for CONUS-based units. Since this operational reality often means assignment of a lower priority FAD (which is identified by a higher number; for example, FAD IV has a lower priority than FAD I) and significantly reduced ordering budgets, (especially for Class IX supplies, namely, repair parts), many of these units tend to forecast future customer demand and unit needs well ahead of time and can then order supplies and repair parts using a low priority.

Table X. Top & Bottom 10 Activities of the Sharpe Top 100 Activities.

Top Ten Units	Bottom Ten Units
1) MCLD, Barstow	91) CMD, Ft McCoy
2) 177th Armor Brigade Fort Irwin	92) Combat Equip Grp SWA, Doha
3) Army Troop Aviation Systems Command	93) 177th SPT BN,* Ft Irwin
4) CPA Toole AFB (Army)	94) 782nd Maint BN,* Ft Bragg
5) USA Intel Ctr, Ft Huachuca	95) 14th CBT Equip CO,* Moenchengladbach
6) FORSCOM Mnt, Ft Lewis	96) 1113th Trans CO,* Sacramento
7) USA Petroleum Ctr, New Cumberland	97) FOMS NO 5 Pineville
8) 6th Support Center,* Taegu	98) Acft Maint Cont Ft Rucker
9) CPO, Sacramento	99) 99th SPT BN,* Ft Lewis
10) GEN SPC SEC Maint Div, Ft Carson	100) Acft Maint Cont 3, Ft Rucker

* = Combat Service Support Unit (CSS)

Note: Complete names may be found in Appendix D

This practice serves a twofold purpose. First, it replenishes the CSS units' Authorized Stockage Lists (ASL) for servicing their own customers. Second, it also satisfies their internal unit needs by replenishing their Prescribed Load Lists (PLL) in addition to accumulating an unauthorized but functional "bench stock". Ultimately, they can only use IPG I upon written approval of the unit commander.

C. IPG I SURCHARGE WIRE DIAGRAMS

1. Data Analysis

The depot model was configured to produce one four-column table as an output file for each of the three supply depots (Oakland, San Diego, and Sharpe), NADEPs Alameda and North Island, and Mare Island and Long Beach NSYs (Appendix D). The first column consisted of flat rate surcharges applied per IPG I order in ten-dollar increments from zero to one hundred dollars. The second column contained a percentage surcharge applied to each IPG I item's unit price. These percentages were increased from zero to ten percent in one percent increments. The table considers all possible combinations of these surcharges to produce a total of one hundred twenty-one surcharge combinations. The third column consists of the difference, or delta, between the Total Variable Cost to Order (TVC_o), and the Total Variable Cost to Stock (TVC_s); that is, delta = (TVC_o - TVC_s). The fourth column contains the difference (NSN_o - NSN_s) between the total number of NSNs ordered using IPG I, (NSN_o), and the total number of NSNs brought into customers' inventories, (NSN_s), for each combination of fixed and percentage surcharges.

For each depot, this table was used to produce two three-dimensional "wire plot" graphs with flat rate and percentage surcharge values on the y and x axes, respectively. The z axis on the first graph is the difference between the number

of NSNs ordered using IPG I and NSNs brought into customer inventories. That graph views the plotted data from the corner having the largest values for the x and y axis. The origin is "hidden".

The graphs for all of the depots reveal that the NSN delta is most positive or least negative at the origin when no IPG I surcharges are applied. San Diego's peak NSN delta at the origin is double that of Oakland (9316 to 4385)(Figures 13 and 14). The wire plot for Sharpe is the only one that reveals a negative NSN delta through its entire range, including the peak (-4145). In other words, at all surcharge levels, more items migrate into stock than are ordered through the use of IPG I at Sharpe (Figure 15). This is because many Army customers requisition supplies using lower priorities in order to replenish their ASLs, accumulate local benchstocks, and accommodate tighter operating budgets.

By comparison, the peak values of NSN deltas for the NADEPs (Figures 16 and 17) are in the 200 - 300 range while NSYs (Figures 18 and 19) exhibit peak values under 50. A likely explanation for this difference is that there are more aircraft and Depot Level Repairable (DLR) overhauls scheduled at the NADEPs than ship overhauls scheduled at NSYs. This larger number of aviation and DLR component overhauls produces a great need for NADEPs to use IPG I to facilitate their rapid turnaround requirements. In contrast, at the NSYs the relatively low number of ships in overhaul at any given time

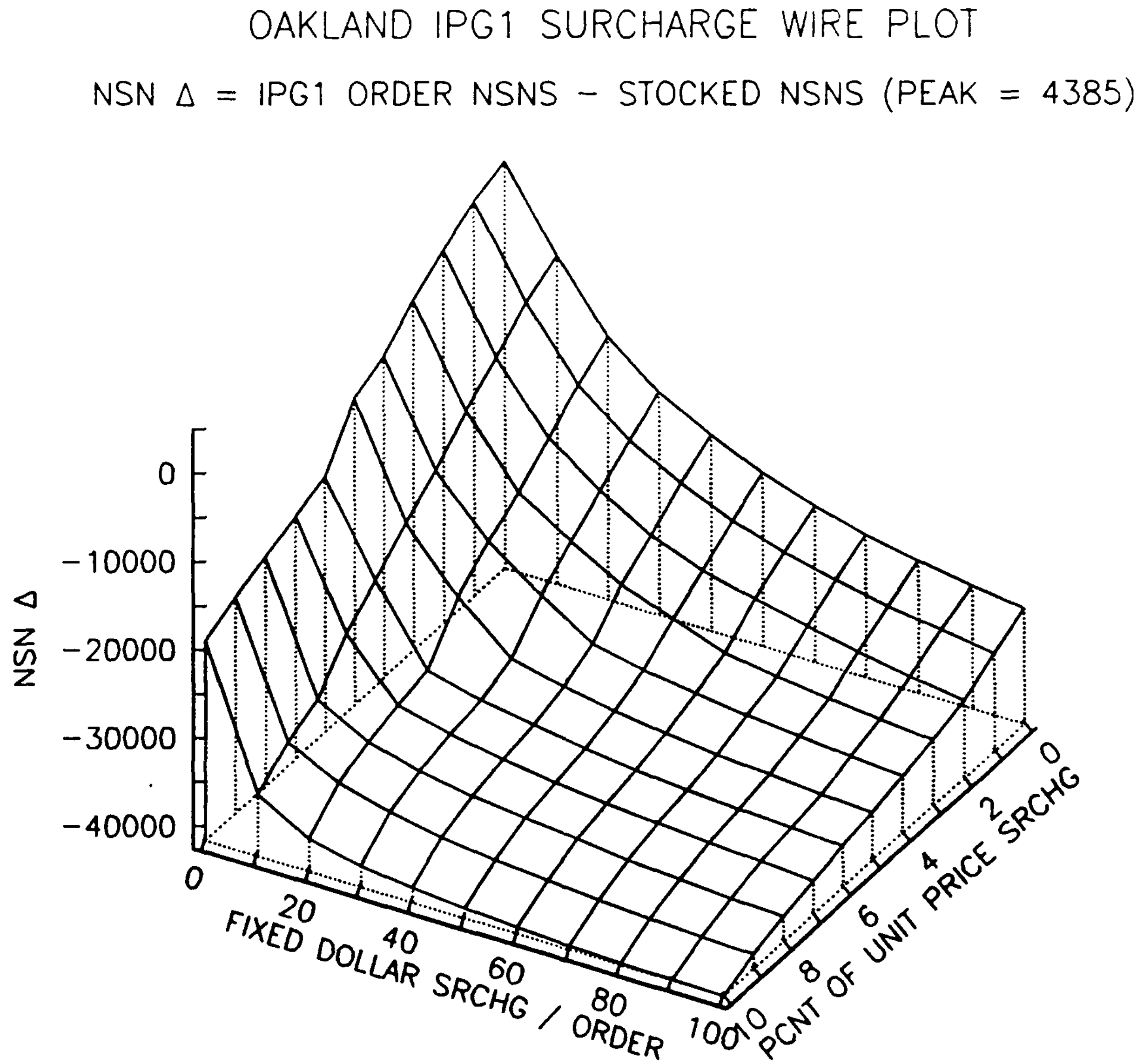

Figure 13. Oakland Three-Dimensional NSN Graph

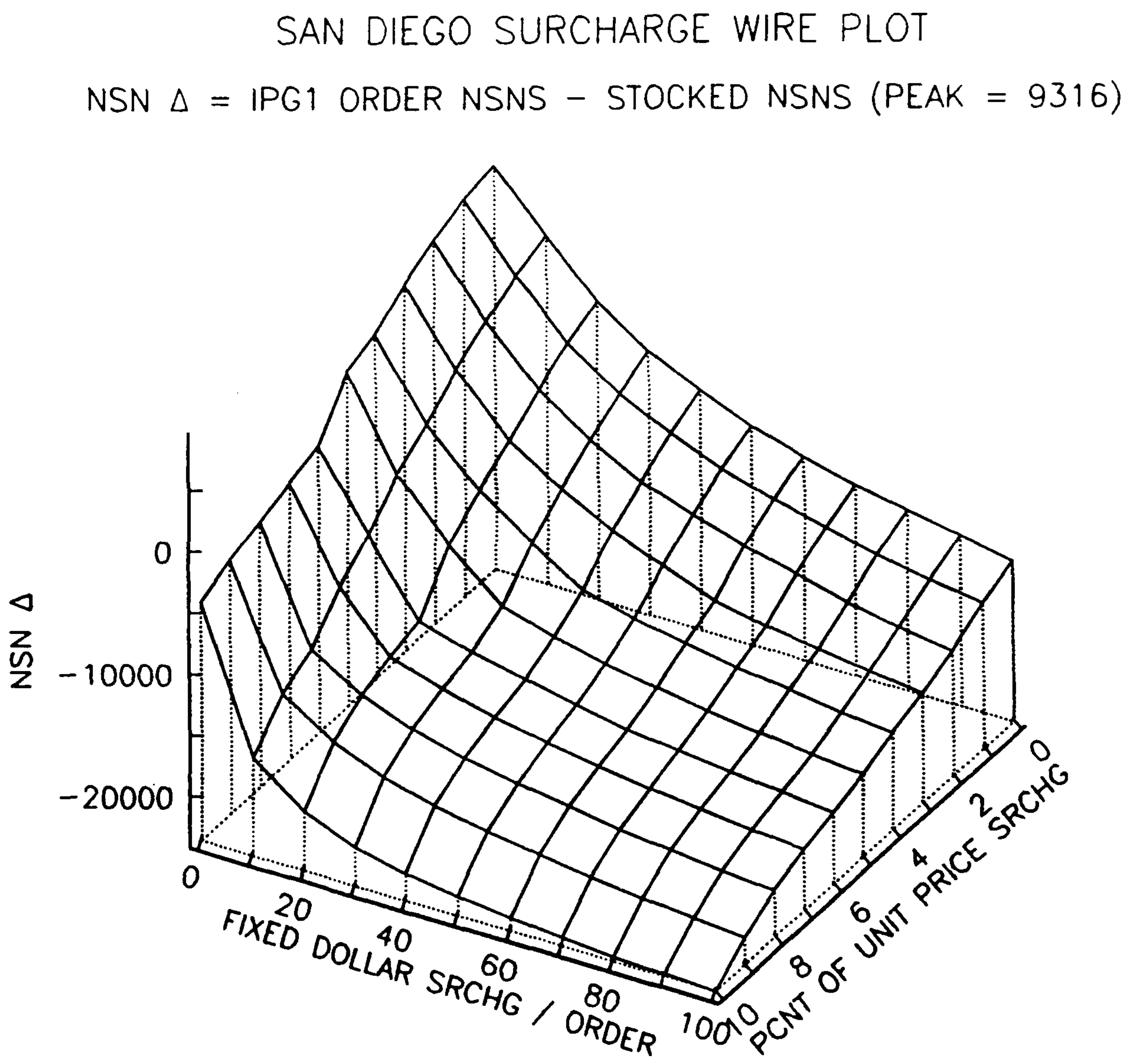

Figure 14. San Diego Three-Dimensional NSN Graph

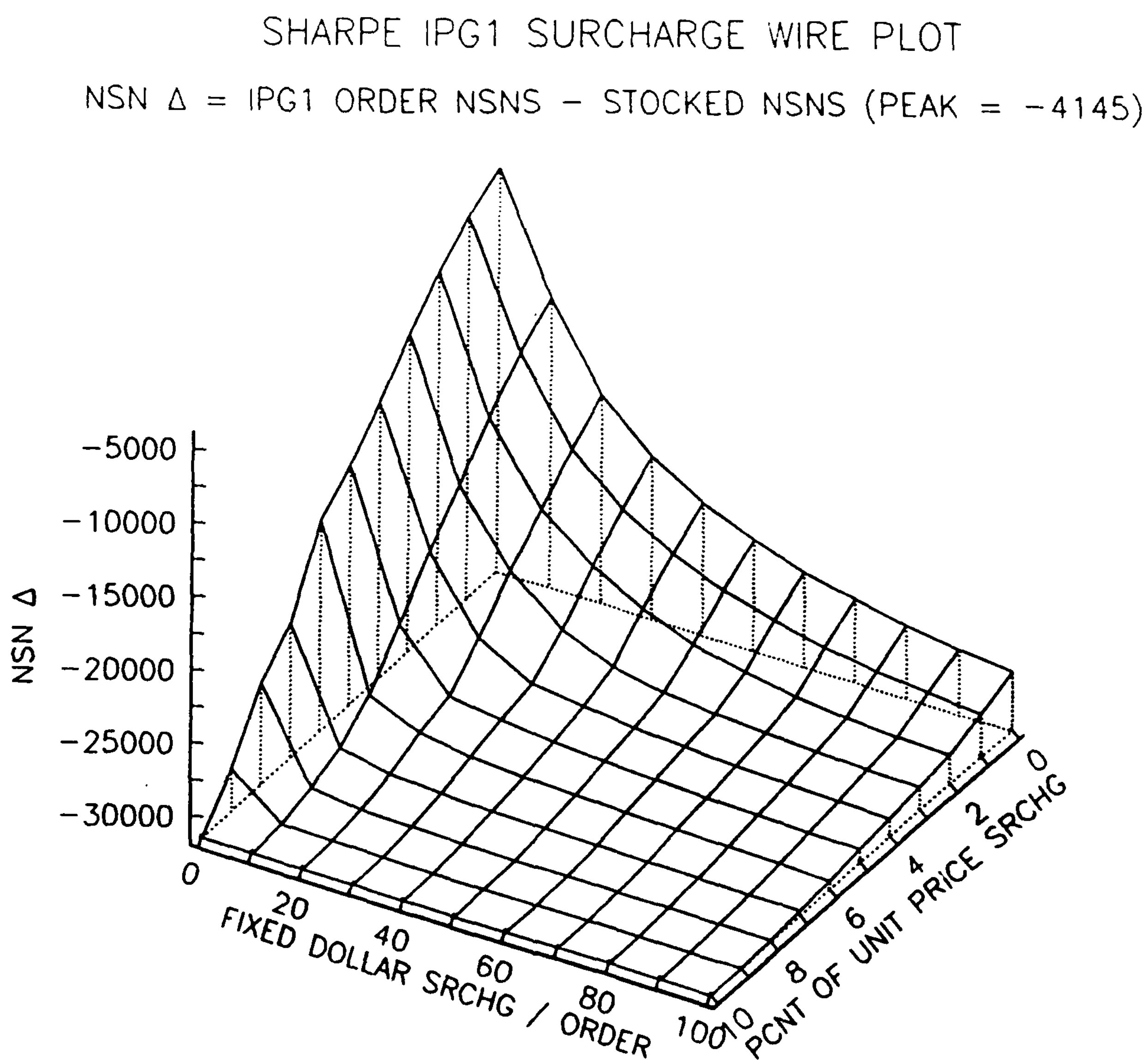

Figure 15. Sharpe Three-Dimensional NSN Graph

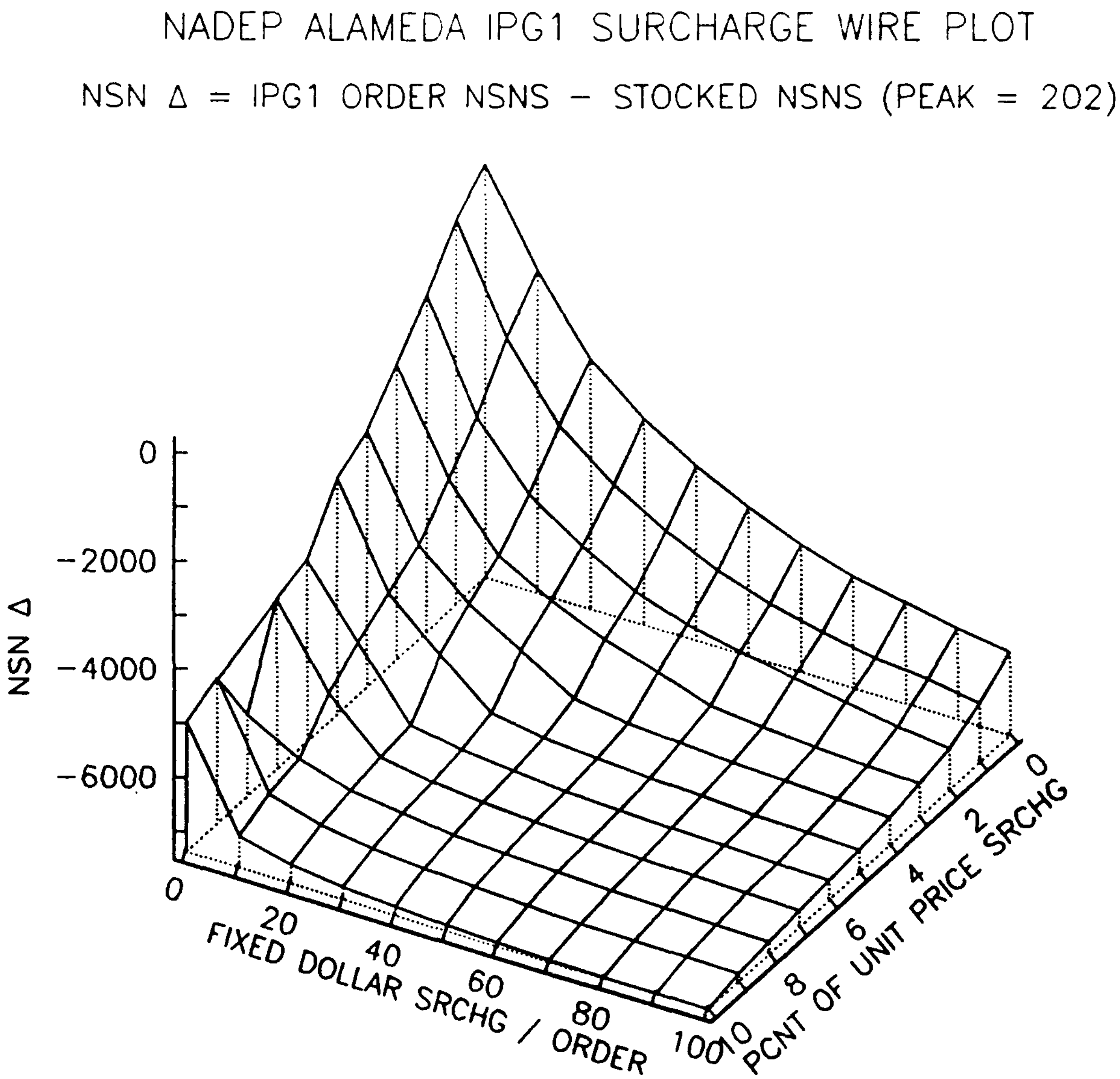

Figure 16. NADEP Alameda Three-Dimensional NSN Graph

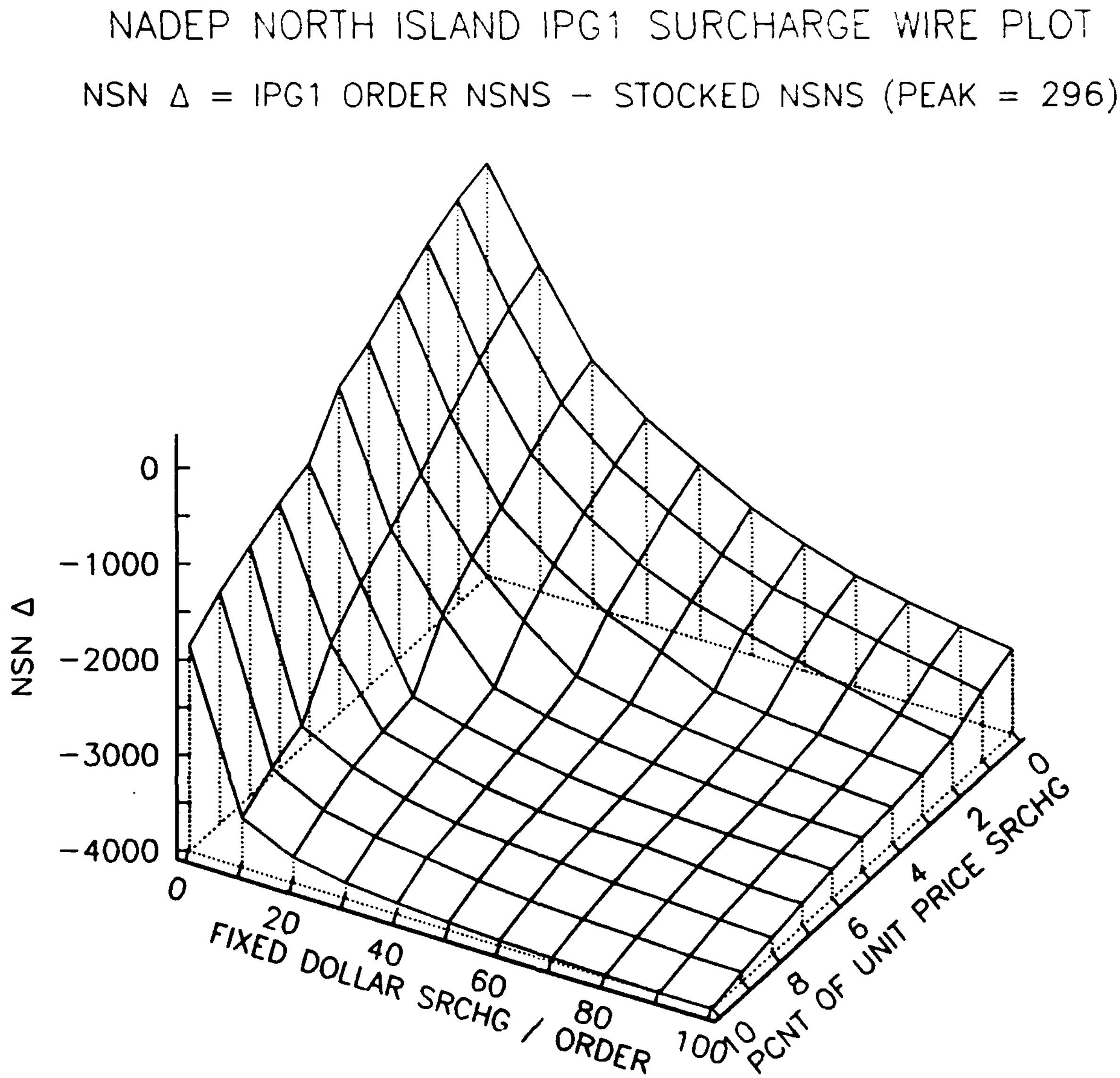

Figure 17. NADEP North Island Three-Dimensional NSN Graph

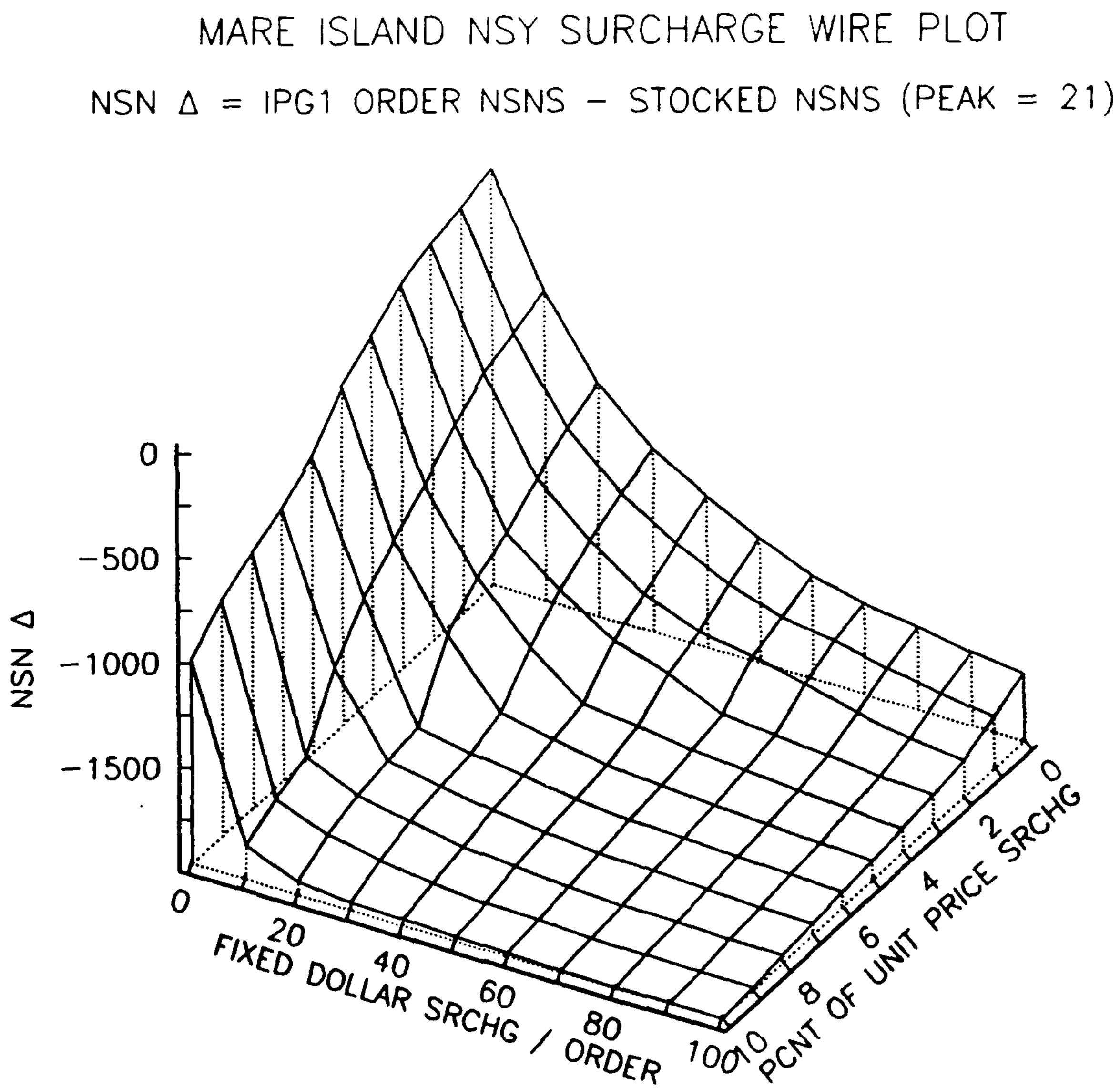

Figure 18. Mare Island NSY Three-Dimensional NSN Graph

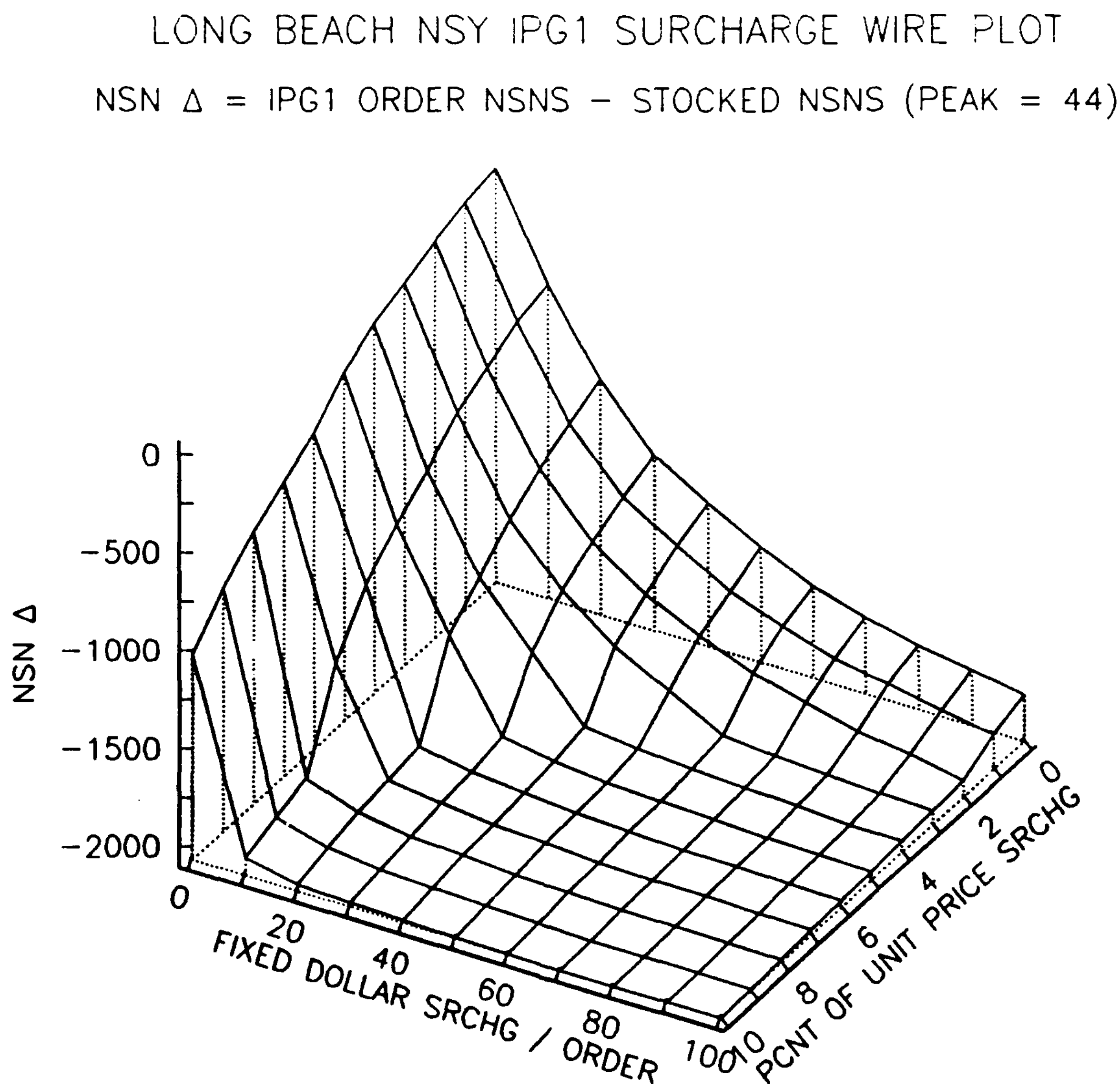

Figure 19. Long Beach NSY Three-Dimensional NSN Graph

allows more flexibility in forecasting material requirements.

From their origin, all of the three-dimensional graphs of NSN deltas fall off steeply into negative NSN delta values as surcharges are levied. In addition, the effect of a flat rate surcharge alone is immediate and remains most pronounced until it reaches forty dollars on the average. After forty dollars, flat rate curves tend to begin to level off. This trait can be explained by the relatively large amount of low-value/high-demand items that are brought into an activity's inventory when modest flat rates are charged. As flat rate surcharges continue to climb, more costly and less demanded items are drawn into stock. However, these shifts occur at a declining rate as the holding costs for the more expensive, less demanded items tend to counterbalance the effects of the flat rate IPG I surcharge.

Percent of unit price IPG I surcharges affect the order versus stock decision relatively evenly. In other words, on all NSN wire charts, the NSN delta tends to plot roughly linearly with percent surcharges levied, becoming increasingly negative as percentages are raised. This characteristic may be explained by frequently requisitioned, high-priced items migrating into stock as the surcharge percentage rapidly overshadows their costs for holding inventory. As the percentage imposed increases, the less frequently requisitioned, lower priced items slowly move into stock.

Combinations of flat rate per order and percent of unit price IPG I surcharges revealed a variety of effects in shifting NSNs from being ordered to their being stocked. The most dramatic of these shifts occurred when flat rates of from zero to ten or twenty dollars were combined with percentage rates from zero to three to five percent. The wire charts then flattened as the fixed and percentage cost continued to increase.

As flat rates were increased, the effects of percentage surcharges became less and less pronounced. When flat rates reached a level of seventy dollars, most NSNs were stocked regardless of percentage surcharges. This trait resulted from IPG I order costs becoming prohibitively expensive with the addition of the flat rate surcharges. The effects of all combinations of flat rates above thirty to forty dollars and percentages above four to five percent were marginal because most items had already migrated into stock.

Finally, it is important to note that when the percent and fixed surcharges had risen to ten percent and one hundred dollars, respectively, over ninety-five percent of all items in each data base examined had been transferred into stock. These surcharge values are the maximums shown in the wire plots.

The second set of graphs present the cost delta on the z axis. This "delta" represents the difference (TVC_o -TVC_s) between IPG I order costs, (TVC_o), and the cost to stock,

(TVC_s). Again, these graphs are viewed from the corner opposite to the origin.

All cost graphs' most positive points are associated with no flat rates, and very low percentage rates (only one, two, or three percent). Oakland's, San Diego's, and both NADEPs' plots reveal definite ridges that peak at one to two, five to six, and ten percent (Figures 20 through 23). These ridges are more pronounced with the supply depots' larger data bases when no flat rates are applied. As the low and medium percentages are combined with progressively higher flat rates, these ridges tend to blend into the rest of the plot. For Oakland, San Diego, and the two NADEPs, the ridge at ten percent drops severely from no flat rate to one hundred dollars. Although with no flat rate the cost delta at ten percent is less than at nine percent, the reverse is true when a one hundred dollar flat rate is added to both.

Both NSYs (Figures 24 and 25) exhibit mild peaks at one and five percent that tend to disappear as flat rate surcharges are combined with these percentages. Both charts also share a fairly flat plateau at combinations of surcharges greater than four or five percent and flat rates above twenty dollars.

Sharpe's plot (Figure 26) also contains a ridge, but at six percent and no flat rate. This ridge is less pronounced, but still noticeable, as flat rates are applied. Otherwise, the graph slopes gradually to its most negative value at one

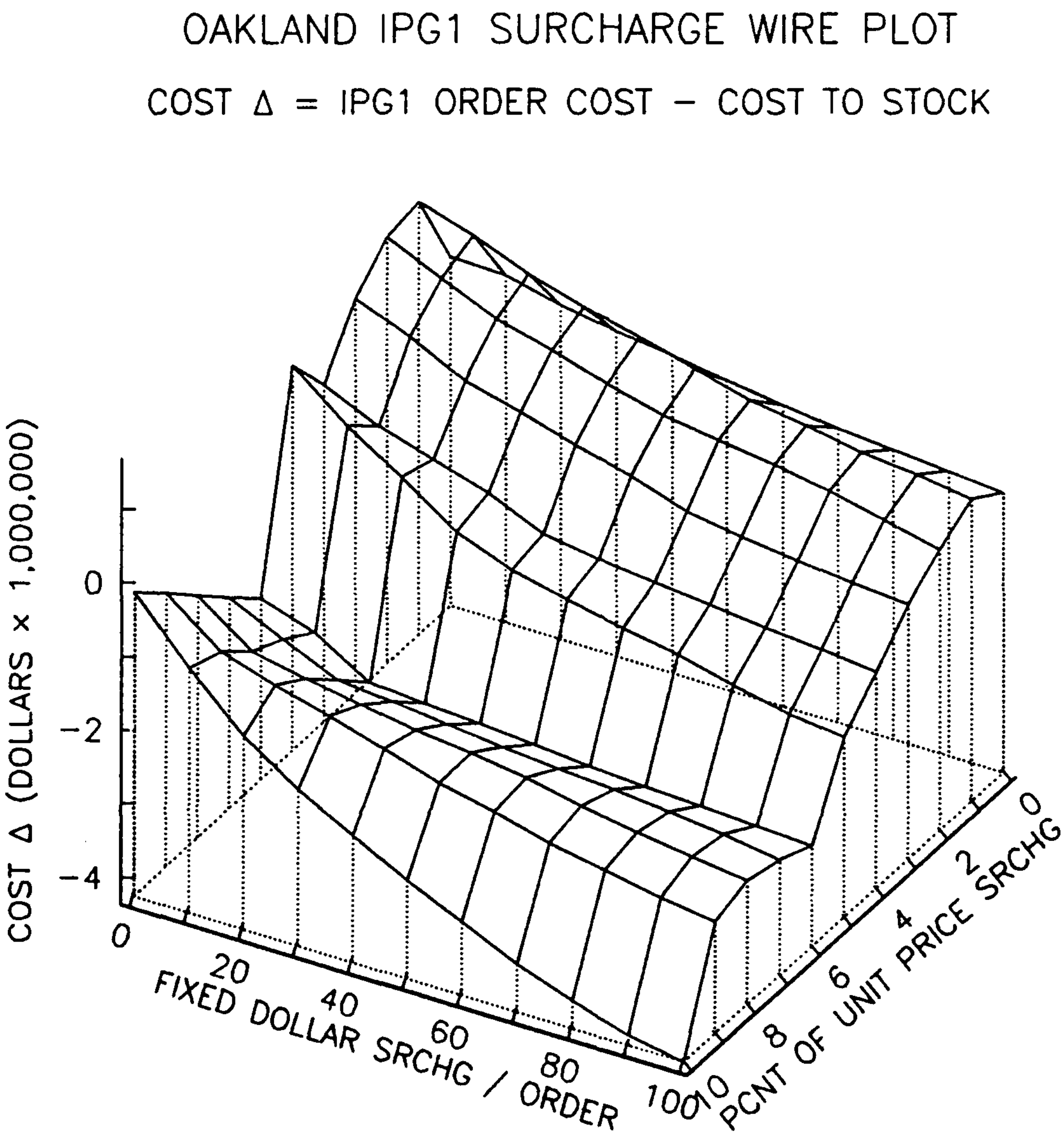

Figure 20. Oakland Three-Dimensional Cost Graph

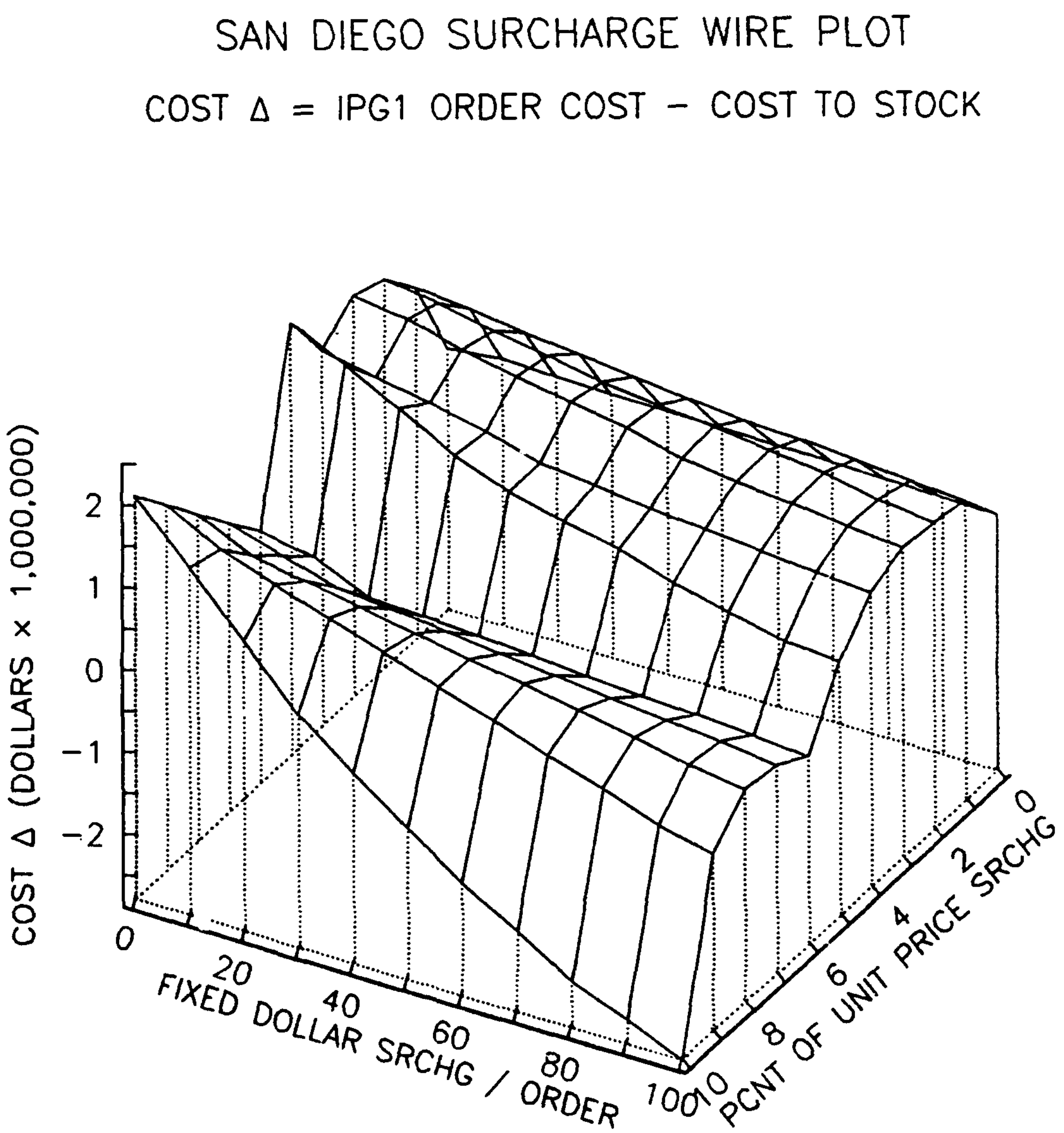

Figure 21. San Diego Three-Dimensional Cost Graph

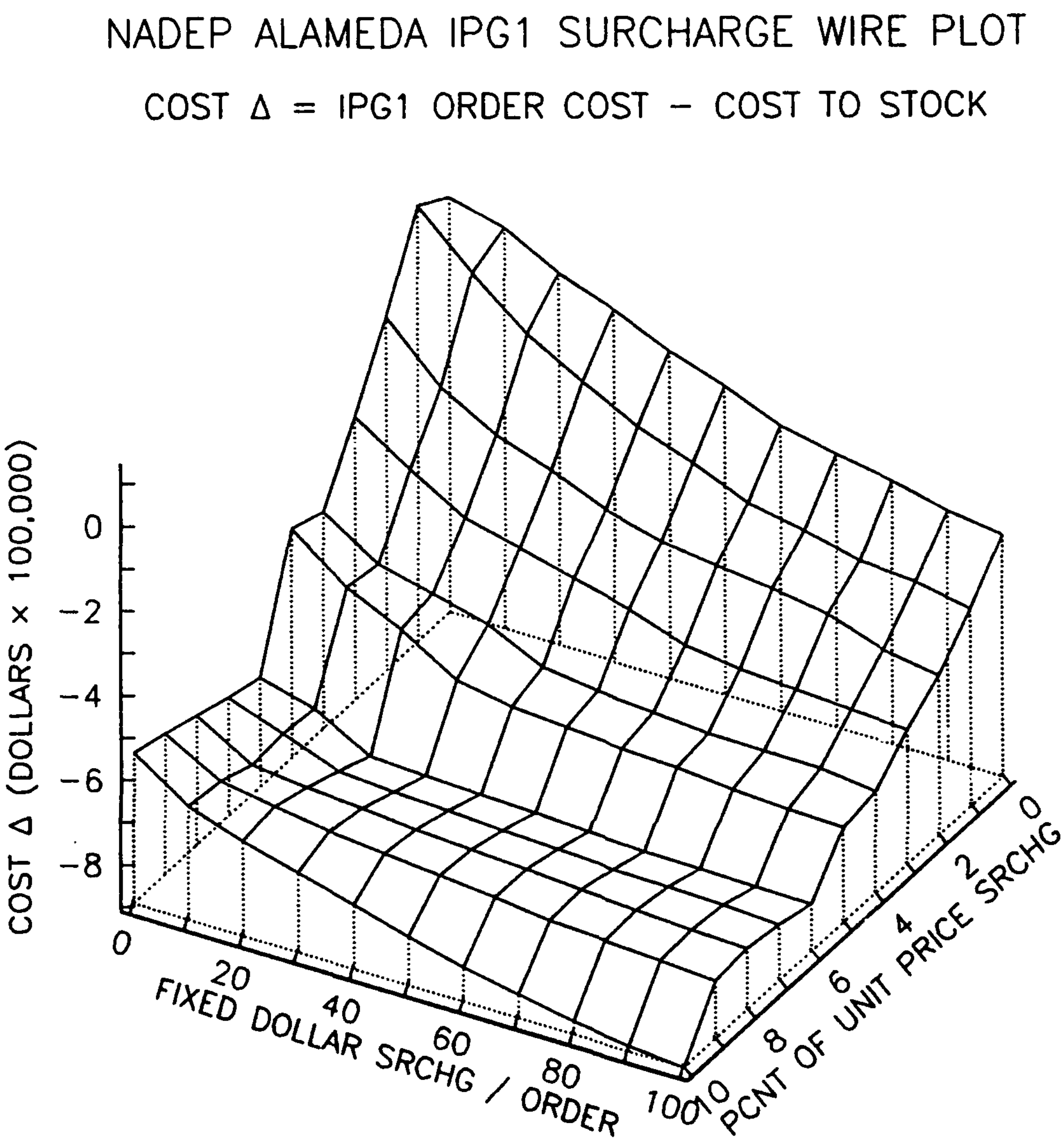

Figure 22. NADEP Alameda Three-Dimensional Cost Graph

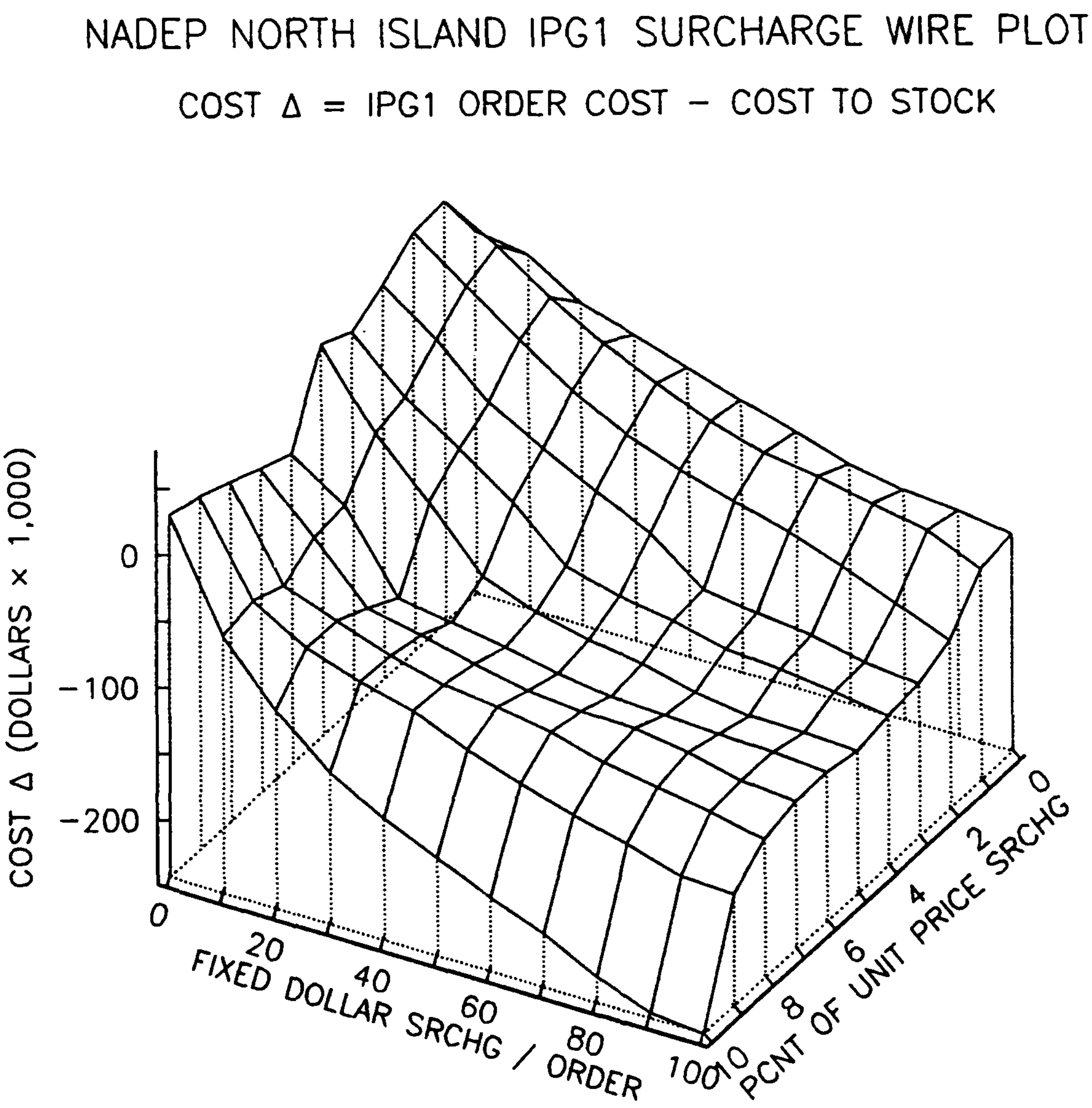

Figure 23. NADEP North Island Three-Dimensional Cost Graph

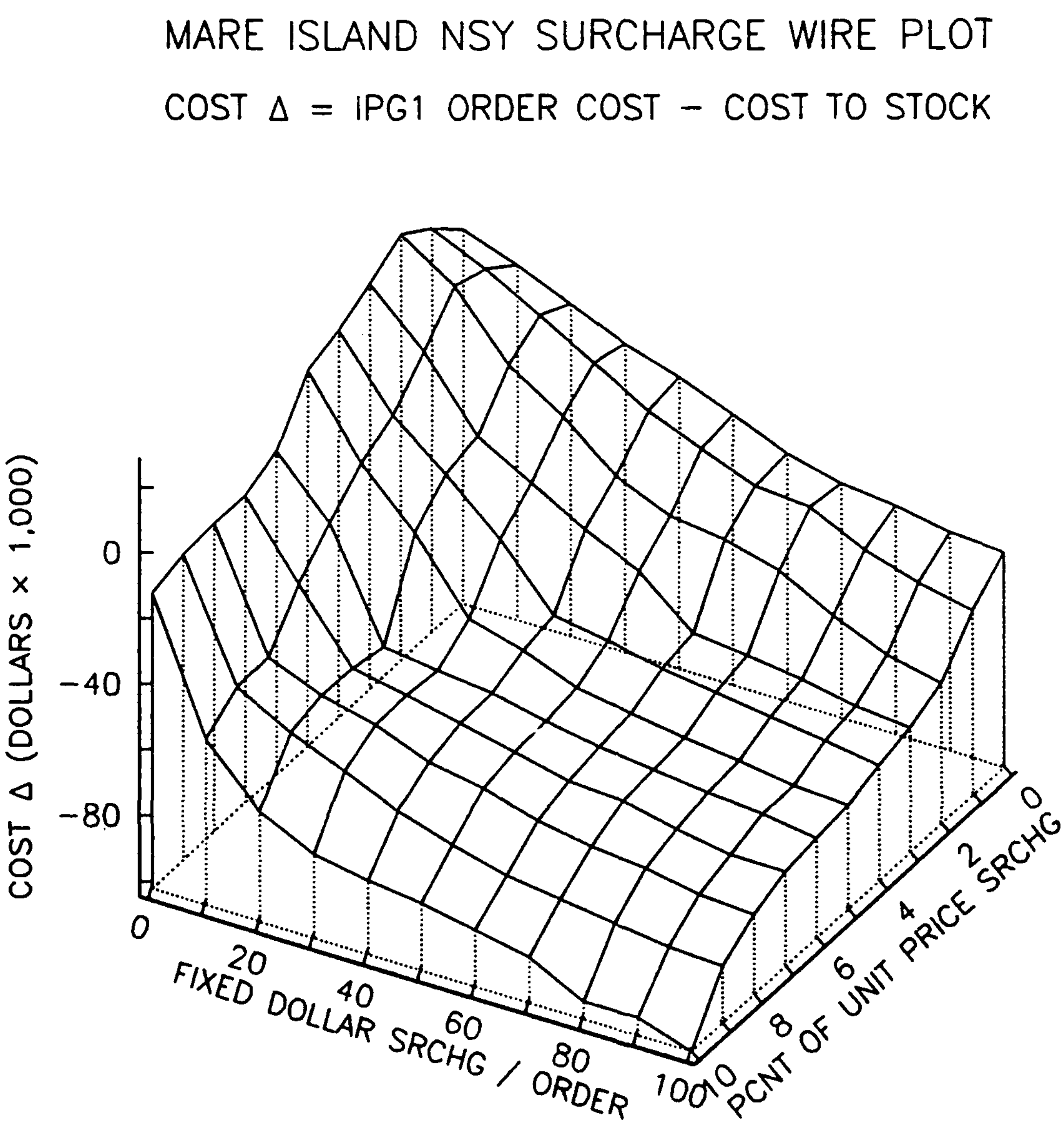

Figure 24. Mare Island NSY Three-Dimensional Cost Graph

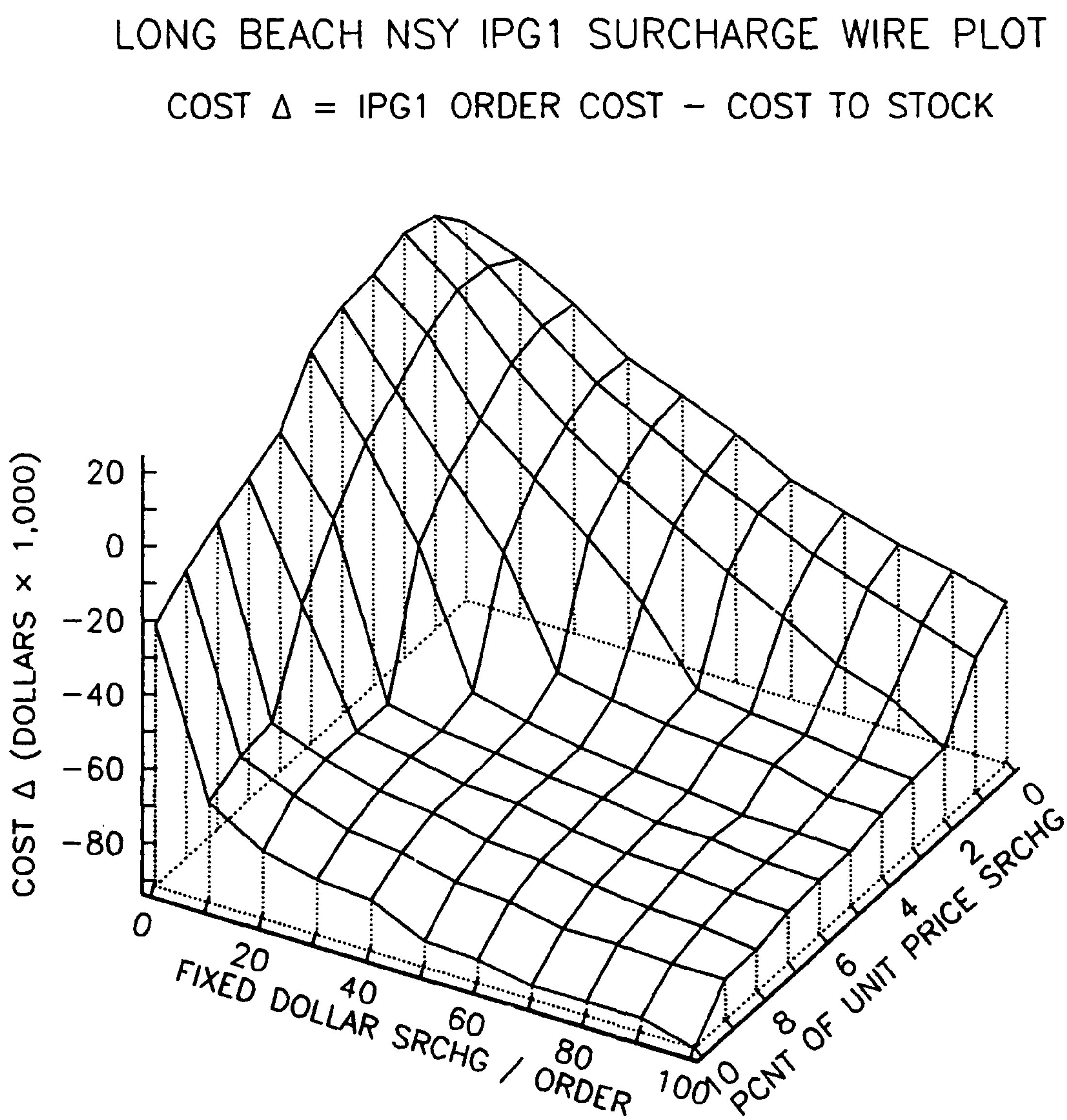

Figure 25. Long Beach NSY Three-Dimensional Cost Graph

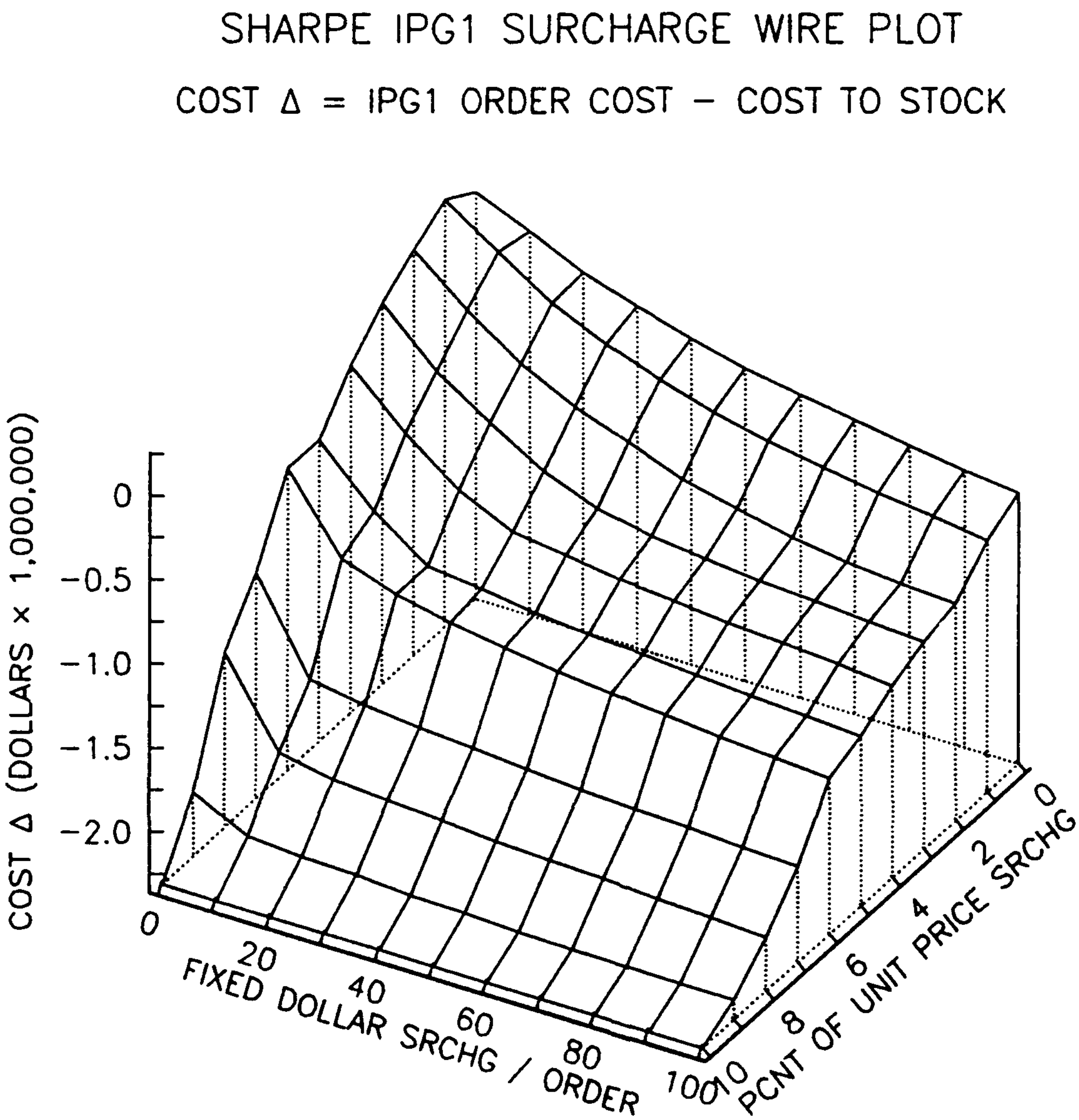

Figure 26. Sharpe Three-Dimensional Cost Graph

hundred dollars and ten percent. In fact, at a surcharge of ten percent there is very little change when higher flat rate surcharges are applied as nearly all items are stocked.

The behavior of these cost deltas is peculiar. The authors had anticipated relatively smooth wire plots similar to the NSN graphs previously discussed. Possible explanations for the interesting behaviors of these wire plots may include the interplay of holding cost rates and order costs with IPG I surcharges and the data. Another potential explanation may lie in the differences between the deterministic model used in this thesis and stochastic modelling. Stocnastic models, an example of which will be discussed in the next chapter, tend to have a smoothing effect on this type of plot's behavior. Study of these phenomena was not possible with the data available. In addition, research of such depth was beyond the scope of this thesis.

D. REQUISITIONS PER NSN INTERVAL TABLES AND POINTS OF INTEREST

After the top IPG I customers had been identified for each depot, programs were written to provide detailed information by NSN for NADEPs Alameda and North Island, and Mare Island and Long Beach NSYs. The output produced by these programs was then analyzed to determine the number of requisitions per NSN, and an indication of the types and quantities of materials being ordered (Appendix E).

The program was designed to produce an NSN list sorted by number of requisitions submitted, in descending frequency, for each NSN ordered, by each activity, during the year under study. The output listings produced by these programs were reviewed by the authors. Individual NSNs were grouped into subsets by number of requisitions submitted per year. The span of these subsets were ten-requisition intervals. These intervals were designed to reveal if activities tended to order the same NSNs, using IPG I, repetitively throughout the year. Interval tables of these subsets and requisition frequencies were then produced for each activity (Tables XI through XIV).

Table XI. NADEP Alameda Requisitions Per NSN Interval.

# of Requisitions per NSN	# of Occurrences
70+	4 (max value = 140)
60 - 69	5
50 - 59	10
40 - 49	13
30 - 39	27
20 - 29	77
10 - 19	343
5 - 9	913
4 - 2	2,610
1	3,498
Total	7,500

As shown in Table XI, NADEP Alameda had the highest number of recurring requisitions of the four activities reviewed. In addition, the authors' review of Alameda's NSN output listings disclosed that the quantity of items ordered per

Table XII. NADEP N. Island Requisitions Per NSN Interval.

# of Requisitions per NSN	# of Occurrences
30+	1 (max value = 30)
20 - 29	8
10 - 19	43
5 - 9	147
4 - 2	841
1	3,058
Total	4,098

Table XIII. Mare Island NSY Requisitions Per NSN Interval.

# of Requisitions per NSN	# of Occurrences
30+	0
20 - 29	1 (max value = 22)
10 - 19	1
5 - 9	15
4 - 2	431
1	1,529
Total	1,977

Table XIV. Long Beach NSY Requisitions Per NSN Interval.

# of Requisitions per NSN	# of Occurrences
30+	0
20 - 29	0
10 - 19	3 (max value = 10)
5 - 9	55
4 - 2	303
1	1,727
Total	2,080

requisition appeared to be fairly low for these NSNs, rarely exceeding three per order. Most of these NSNs were for engine parts, packing and gasket materials. There were, however, a few clear instances of ordering for bench stock. For

example, 8,035 units were ordered on 23 separate requisitions for one NSN, priced at forty-three cents each.

NADEP North Island (Table XII) exhibited basically the same trends as Alameda, but with less highly repetitive requisitioning of a few NSNs. Like Alameda, North Island tended to order aircraft materials in fairly low quantities and also had a few obvious cases of ordering bench stock using IPG I.

The number of IPG I requisitions submitted during the period studied by each NSY was approximately half the total submitted by NADEP North Island, and less than one-third of the total submitted by Alameda. As a result, the number of repeat requisitions for a given NSN was fairly low. Both shipyards tended to order generic industrial materials (pipe, welding supplies and fittings) vice specific repair parts. This ordering pattern makes it more difficult to determine whether or not bench stocks are being ordered as these types of materials may be ordered by the foot vice by the piece. However, there appeared to be instances of bench stock replenishment as both shipyards issued repetitive requisitions for fairly large quantities of items such as circuit breakers. Interestingly, four of the top five IPG I requisitions ordered by Long Beach NSY were for compressed or liquified gases. Gases are usually procured from commercial sources and these IPG I requisitions seem to indicate a lack of discipline

in management of Class III supplies (Class III includes petroleum, oil, lubricants and gases).

When all four activities are grouped, the following trend appears to be consistent. There were IPG I requisitions for high-demand/low-cost items which seems to indicate these requisitions were meant to replenish PEBs. The need to replenish these PEBs using IPG I seems to indicate inadequate inventory control procedures. PEB's normally use the standard stochastic model with service levels and have two bins so that when the first bin is empty an order will placed. The second bin is the reorder point inventory.

VI. THEORETICAL IPG I SURCHARGE EFFECTS MODEL

A. REQUIREMENTS DEFINITION

The deterministic model developed for this thesis exploits the data provided by the three supply depots in the fullest manner possible. In addition, it provides a working baseline from which to explore the implications of imposing an IPG I surcharge. But, due to the limitations of the data, the role of customer reorder point calculations could not be addressed. Missing were accurate measures of customer lead time and lead time demand. This lead time spans the time interval from initial requirement definition through material receipt by the requisitioner. In addition, a customer backorder cost was not available and would be extremely difficult to accurately estimate. However, since IPG I as a requisition class is used to make the lead time as short as possible, the shortage cost implied is high.

Lead time is a critical parameter in reorder point calculations. An incorrect reorder point value can result in either late arriving orders and therefore stockouts, or early arriving orders creating excess stocks and perhaps inefficiently large inventories. The reorder point is a level to which inventory must fall to in order to trigger a restocking requisition. Knowledge of lead time is necessary

to ensure an order is received when desired, hopefully just as stocks reach zero. Quantity demanded during the lead time is also critical in reorder point calculations. Even if lead time is known precisely, the quantity demanded during lead time typically varies according to some probability distribution.

In the deterministic EOQ model, described in Chapter III, both lead time and quantity demanded during lead time are assumed to be known and constant. Therefore, the implicit assumption is that the decision maker will always correctly calculate the reorder point so that replenishment requisitions will be received exactly when required. In reality, both quantity demanded during lead time, and lead time itself, can and do vary. Thus, a more precise model would allow lead time, and quantity demanded during lead time, to vary by relaxing the deterministic assumptions of knowledge and consistency.

By studying the actual range, and frequency of occurrence of each value in the range, the distribution characteristics of both of these factors emerge. These characteristics form the basis for generating a joint probability distribution that reflects real world lead time and demand. Armed with this joint distribution, a decision maker can calculate a reorder point which incorporates the lead time and lead time demand probabilities. In particular, a decision maker can evaluate chances of stockout for a given reorder policy and develop

safety stock levels to reduce this possibility to acceptable levels.

The level of safety stock carried is directly related to the cost to an activity of being unable to fill a requirement upon demand, in other words, the backorder cost. If that cost is known, inventory managers can use well-known models to find the optimal tradeoff between inventory holding costs and backorder costs. If backorder costs are low and stockouts can be tolerated, then the amount of safety stock carried will be low. If backorder costs are high, the amount of safety stock carried in inventory will also be high.

Unfortunately, backorder costs are never really known, not even in the private sector. They are frequently based on vague measures such as a decline in unit readiness, lost production of output or completion delays. Therefore, a quantitative backorder cost estimate often can only be implied by assuming a theoretical model and then reviewing an activity's ordering policies. In other words, the level of safety stock which an activity is comfortable with provides an indication of whether their backorder costs are high or low.

Since some sort of theoretical model is needed before the backorder cost can be implicitly determined, we propose the following model as a first step towards understanding how inventory operating policies and backorder costs are related.

B. VARIABLE LEAD TIME DEMAND SURCHARGE MODELLING

The stochastic model which provides a simple structure for a stochastic IPG I surcharge model with variable lead time demand is the stochastic model where stockouts result in lost sales (Tersine '88). This model would be appropriate if each unit demanded when there is no stock is ordered IPG I at a much faster rate than regular replenishment ordering. In other words, in the event of a stockout, one-for-one ordering would be done and therefore Q would be reduced by the total expected amount of such orders. Under these conditions, the optimal solution for how much to order, Q, and when to order, B (the reorder point), is an iterative procedure that begins with the initial value of Q being determined using the deterministic EOQ formula described in Chapter IV. This deterministic formula is identical to equation 6 when E(M > B) is set equal to zero. Equation 7 is used to derive the expected lead time stockout, E(M > B), in the remainder of the iterative process.

$$Q_0=\sqrt{\frac{2R[C+AE(M>B)]}{H}}; \qquad (6)$$

$$E(M>B)=\sum_{M=B+1}^{M_{max}}(M-B)\,p(M); \qquad (7)$$

where

Q_o = Economic Order Quantity in Units;

R = Average Annual Demand in Units;

C = Ordering Cost per Order;

A = Stockout Cost per Unit;

E(M > B) = Expected Lead Time Stockout in Units;

H = Holding Cost per Unit per Year;

M_{max} = Maximum Lead Time Demand in Units;

M = Lead Time Demand in Units;

B = Reorder Point in Units; and

p(M) = Probability of Lead Time Demand of M Units.

After the order quantity has been determined it is used in equation 8 to determine the optimal stockout probability if the stockout cost per lost sale is known (Tersine '88).

$$P(M>B) = \frac{HQ}{AR+HQ}; \tag{8}$$

where

P(M > B) = Probability of a stockout just before the requisitioned order of Q units arrives;

M = Lead Time Demand in Units (random variable);

B = Reorder Point in Units;

H = Holding Cost per Unit per year;

Q = Order Quantity (determined by Equation 6);

A = Backorder (Stockout) Cost per Unit; and

R = Average Annual Demand in Units.

This stockout probability is then used with the lead time demand probability distribution to determine B.

Reorder point determination begins by developing a table based on lead time demand (M), the corresponding probability of occurrence p(M), and the computed probability of stockout P(M > B). An example is shown in Table XV.

Table XV. Example of a Probability of Stockout Table

Lead Time Demand (M)	Probability p(M)	Stockout Probability P(M > B)
0	.1960	.8040
1	.2310	.5730
2	.2260	.3470
3	.1797	.1673
4	.0935	.0738
5	.0477	.0261
6	.0190	.0071
7	.0053	.0018
8	.0015	.0003
9	.0003	.0000
	1.0000	

The calculated optimal stockout probability (i.e., calculated from the right-hand side of Equation 8) is matched with the joint probability table to determine the reorder point. For example, if the calculated optimal stockout probability from equation 8 is .0017, the reorder point (B) (from Table XV) would be set at eight units. Eight units would be selected because it is the lowest potential reorder point with a probability of stockout that is less than .0017.

The reorder point is then used in calculating the expected lead time stockout in units (equation 7). This expected lead time stockout value is used in equation 6 to begin the second iteration of the process to determine an optimal Q and B.

However, equation 6 also needs a value for the backorder cost.

IPG I surcharges may be incorporated into this process by using them as part of the backorder cost value. As noted above, the assumption is made that the only time IPG I orders will be submitted to the supply system will be when the activity is out of stock and forced to reorder one-for-one using high priorities (lower requisitioning priorities are expected for routine stock replenishment orders).

Backorder costs for this model must be determined on a per unit basis. The addition of percent of unit price surcharges would be accomplished by multiplying the surcharge percentage and unit price and adding this product, S_p, to other backorder costs to produce total backorder costs. The addition of a flat rate surcharge, S_f, would be accomplished as in the thesis model of Chapter 5, by adding its value directly to the other backorder costs. Thus, the formula for the per unit backorder cost, A, when both surcharges are applied would be:

$$A=S_p+S_f \tag{9}$$

These backorder costs would be incorporated in the iterative process described throughout this section. Once an optimal Q and B have been determined by the process, the following equation may be used to determine annual total variable costs to stock the items with surcharges:

$$TVC=\frac{R}{Q}[C+AE(M>B)]+H[\frac{Q}{2}+(B-\overline{M})+E(M>B)] \qquad \textbf{(10)}$$

where

R = Annual Demand in Units;

Q = Order Quantity (as determined by Equation 6);

C = Ordering Cost per Order;

A = Stockout Cost per Unit;

E(M > B) = Expected Lead Time Stockout in Units;

H = Holding Cost per Unit per Year;

B = Reorder Point in Units; and

$\overline{M}$ = Average Leadtime Demand in Units.

In summary, the model described in this chapter would be more realistic and allow greater precision than the deterministic EOQ model, where no backorders are allowed. Unfortunately, the difficulties inherent in obtaining probability distribution for lead time demand, for all items of interest suggest that this stochastic model may be impractical.

VII. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The objective of this thesis was to examine the effects of a DLA IPG I requisitioning surcharge on ordering decisions and inventory management by retail activities. As discussed in Chapter I, this study required data to be gathered from three DDRW supply depots (Oakland, San Diego and Sharpe) for the period from 1 June 1991 to 30 May 1992 (Sharpe was only able to provide data from 1 January to 25 August 1992).

Chapter II discussed DoD's official IPG I policies and requisition processing time standards. This chapter then addressed actual retail customer IPG I ordering practices. The remainder of the chapter was devoted to brief reviews of each supply depot's history, and in-depth analysis of each of their IPG I customer bases.

Alternatives to control IPG I requisitions were reviewed in Chapter III. The chapter began by reviewing customer reasons for using high priorities in requisitioning and the differences between industrial and operational unit uses of IPG I. Three alternatives to control IPG I requisitions included (1) aggressive DLA enforcement of UMMIPS ceilings on the percentage of total requisitions that may use IPG I; (2) automatic downgrading of IPG I orders that do not cite

required entries in various requisition data fields; and (3) introduce IPG I requisition surcharges. These surcharges could be restricted to certain types of customers, or imposed only after a ceiling amount of IPG I requisitions, or percentage of total requisitions submitted, is reached.

Evolution of the model developed to study the impact of IPG I surcharges on customers was the subject of Chapter IV. Projects completed for two NPS logistics courses were reviewed in detail. These reviews were followed by a discussion of requirements for the thesis model. These requirements included development of a model sensitive to industrial activities' needs. In addition, the model had to take into account the limitations of the data provided by the supply depots. These prerequisites dictated development of a model based on the deterministic EOQ model. The model, and parameter values used, was described in depth. This description concluded by briefly examining the tradeoff decision between continuing to order an item using IPG I, or establishing stocking policies and bringing the item into inventory.

Chapter V began with an A-B-C analysis of each supply depot's top customers. This analysis revealed that the Navy's Oakland and San Diego depots support predominantly Navy activities and the local industrial and aviation units were the major customers. As a consequence, the slope of the A-B-C curves were relatively steep. If such industrial units did

not clearly dominate the list of top customers, as is the case at Sharpe, the slope of the A-B-C curve is less steep.

Three-dimensional "wire plot" graphs were then constructed based on the model described above to examine changes in items stocked as IPG I surcharges were imposed. First, three-dimensional graphs were plotted to study changes in number of items carried for various IPG I surcharge combinations. These plots were created for all three supply depots that provided data, and both Oakland's, and San Diego's most prolific IPG I customers (two NADEPs and two NSYs). The NSN graphs disclosed that flat rate surcharges per IPG I order had a significant impact at relatively low values (less than forty dollars). This impact diminished as this flat rate surcharge increased. Percentage surcharges, on the other hand, tended to have a relatively even impact on the order versus stock decision as they were increased. Combinations tended to cause most items to become stocked rapidly. After this initial surge, the effects of surcharge combinations diminished quickly as relatively few items were still being ordered.

Next, three-dimensional graphs were plotted of the changes in costs as surcharges were applied. Unfortunately, these were difficult to interpret. All plots exhibited peaks and ridges that were not expected by the authors. Possible reasons for this behavior included holding cost rates used, and characteristics of the data. These peaks and ridges may

also disappear with the use of more sophisticated stochastic modelling techniques.

The final analysis technique used was the development of tables showing the numbers of IPG I requisitions submitted per NSN for the year studied for NADEPs Alameda and North Island, and Mare Island and Long Beach NSYs. These tables showed a large number of repeat IPG I requisitions for some NSNs, especially by the NADEPs. Further review of the data revealed that most of these orders appeared to be for quantities of three or less and were for repair parts. There were, however, some clear indications that Pre-Expended Bin (PEB) items were being restocked using IPG I requisitions.

Chapter VI proposed a theoretical IPG I surcharge model which provides for realistic random lead time demand. The model suggested is a well-known lost sales model. The chapter began by emphasizing that the most important requirement for the model is data for determining the lead time demand distribution. The chapter then presents the model and its iterative solution process. It also shows how the "lost sales" costs can be generated by the surcharges.

B. CONCLUSIONS

There are several conclusions that can be drawn from this thesis. First, DoD's UMMIPS standards have been interpreted in a wide variety of ways by both wholesale activities and their retail customers. For example, our interviews indicate

that many believe UMMIPS IPG I time standards are requirements imposed upon the supply system. Actually, they are performance averages that supply activities are expected to meet. Therefore, some IPG I requisitions may be filled faster than UMMIPS standards, while others may take longer to be completed. In addition, industrial activities have been extremely liberal in their interpretations of both IPGs and FADs that they are allowed to use. DoD auditors have disputed this interpretation in the past (DoD Audit Report #88-118). In spite of this disagreement, industrial activities have continued to feel required to generate large volumes of IPG I requisitions to meet ambitious turnaround time requirements.

In this environment IPG I surcharges make sense. Unlike the "cat and mouse" game currently being played by DLA through their automatic downgrading policy, surcharges allow the retail activity to decide whether IPG I responsiveness is worth the additional premium they must pay in surcharge costs. Depots would be less averse to handling these requisitions as they would be compensated by the surcharge for the costs they incur in providing IPG I responsiveness.

However, there is a significant downside to imposing surcharges. First, an argument may be made that operational units should be excused from paying IPG I surcharges. If these units were excused, the surcharge mechanism could rapidly become very complicated. For example, Navy operational units are identified by "R" or "V" service

designators. These designators are also used by MALS and SIMAS, and may be used by NSYs to submit requisitions for ships they are overhauling. How would DLA determine whether a service designator is for a legitimate operating unit?

In addition, what if a retail customer has decided to order using IPG I and accept the surcharge and they do not receive their requisition in a timely manner? The supply system is not required to meet UMMIPS time standards exactly, but rather on the average. As described by one industrial material manager (Wilcoxen '92), DLA already imposes a surcharge to cover their overhead. If an additional IPG I surcharge is imposed and paid, these requisitioners have a right to expect increased responsiveness. If the supply system is not reasonably responsive, these customers should have a right to demand refunds of the IPG I surcharges they paid. This refund process could also greatly complicate any IPG I surcharge mechanism.

If DLA decides to go ahead with a surcharge policy, our research indicates that a modest flat rate per order may be the most effective and equitable. The greatest impact of this type of surcharge is on repetitive requisitions for relatively inexpensive items. These items can and should be stocked by retail customers. Maintaining inventories of these items has the additional benefit of improving the retail activity's support of their own customers. In addition, modest flat rates will probably not force expensive, low demand items

into a retail customer's inventory. As holding costs for these items are also expensive, it is more cost effective for DoD as a whole to maintain consolidated inventories of these items at the wholesale vice retail level.

Finally, a modest flat rate surcharge would be more equitable because it can be easily tied to the additional cost to the supply system of providing IPG I responsiveness. These costs are probably not closely related to the price of an item.

C. RECOMMENDATIONS

This thesis presents additional evidence that IPG I, as defined by UMMIPS, is incorrectly applied and overused. There are several methods available to curb this abuse, including IPG I surcharges. Our recommendations combine a variety of these methods with a goal of insuring increased efficiency within the supply system. A by-product of this increased efficiency may be, but does not necessarily include, a reduction in IPG I requisitioning.

The bottom line is that UMMIPS and its time standards should be revised. The new system should clearly define and segregate operational, industrial, and support activities. Within each category, enforceable policies should be developed to define which requirements are legitimately high priority. As these activity types are very different, these requirements will also be very different within each category.

For operational units there are already inspection mechanisms in place to insure rigid enforcement of IPG I ordering standards. Therefore, they should be excused from paying IPG I surcharges.

The current policy in DoD under DBOF is to require industrial and support activities to compete with each other and the private sector as if these activities were commercial firms. Imposing a surcharge for the increased responsiveness of IPG I on these activities is consistent with this policy by forcing these activities to pay for services received, and allowing the supply system to recover the costs of the services it provides. Supply system provision of IPG I responsiveness is, in many ways, similar to a parts wholesaler offering to ship items to customers using Federal Express for an additional fee. In addition, this surcharge policy would provide the incentive for these activities to moderate IPG I ordering, eliminating inspection requirements.

Industrial and shore activities ordering using IPG I with a surcharge should, however, receive some type of guarantee that their ordered material will be delivered within a specified time period. If the supply system fails to meet this guarantee, these activities should be entitled to a surcharge refund. In addition, these activities should be allowed to compete the DLA supply system with the private sector. In other words, if Lockheed can deliver a part faster and cheaper than DLA can, NADEP Alameda should be

allowed to buy the part from Lockheed and not be required to use DLA. The amount of business generated by such actions is a topic which lends itself to further research.

There are several aspects of the problem left unexplored. First, all three supply depots also provided us with IPG II and III data. At one time, our intention was to use this data in our research. Unfortunately, due to time constraints, we were unable to do so. The data remains available at NPS for others to carry on this work. One aspect would be to examine the effects of IPG I surcharges on lower IPG ordering practices. Second, future modelling and research efforts should attempt to reduce the infeasibility of the stochastic model described in Chapter VI. To accomplish this effort, demand data over several years will be required.

APPENDIX A. TOP SEVENTY-FIVE OAKLAND UNITS

	UIC	#IPGI Reqns	Activity
1)	65885	7,500	Naval Aviation Depot, Naval Air Station, Alameda, CA
2)	00221	1,977	Naval Shipyard, Mare Island, CA
3)	00296	1,706	Naval Air Station, Moffett Field, Mountain View, CA
4)	00311	1,529	Pearl Harbor Naval Shipyard, Pearl Harbor, HI
5)	00334	1,462	Naval Air Station, Barbers Point, HI
6)	62758	1,319	Ship Repair Facility, Yokosuka, JA
7)	68251	1,182	Shore Intermediate Maintenance Facility, Pearl Harbor, HI
8)	48758	1,109	Naval Air Pacific Repair Activity Plant Detachment Office, Atsugi, JA
9)	00246	1,060	Naval Air Station, North Island, CA
10)	00251	1,040	Puget Sound Naval Shipyard, Bremerton, WA
11)	21297	1,008	USS ABRAHAM LINCOLN (CVN-72)
12)	00620	999	Naval Air Station, Whidbey Island, WA
13)	00236	912	Naval Air Station, Alameda, CA
14)	61577	868	Naval Air Station, Guam, MI
15)	62876	862	Naval Air Station, Cubi Point, RP
16)	68831	793	Shore Intermediate Maintenance Activity, San Francisco, CA
17)	62586	760	Ship Repair Facility, Guam, MI
18)	09124	714	Marine Aviation Logistics Squadron 24, Kanoehe Bay, HI
19)	03362	666	USS INDEPENDENCE (CV-62)
20)	63126	583	Pacific Missile Test Center, Point Mugu, CA
21)	60200	547	Naval Air Station, Cecil Field, Jacksonville, FL
22)	09112	544	Marine Aviation Logistics Squadron 12
23)	60462	535	Naval Air Station, Adak, AK
24)	60259	491	Naval Air Station, Miramar, CA
25)	68212	468	Naval Air Facility, Misawa, JA
26)	65886	440	Naval Aviation Depot, Naval Air Station, Jacksonville, FL
27)	B2049	418	Sacramento Air Logistics Center, McCellan Air Force Base, CA
28)	45598	415	Ship Repair Facility Detachment, Sasebo, JA
29)	65923	405	Marine Aviation Depot, Cherry Point, NC
30)	09136	378	Marine Aviation Logistics Squadron 36

31)	00421	357	Naval Air Test Center, Patuxent River, MD
32)	B2029	356	Ogden Air Logistics Center, Hill AFB, UT
33)	00314	341	Submarine Base, Pearl Harbor, HI
34)	68539	339	Navy Support Facility, Diego Garcia
35)	60258	338	Naval Shipyard, Long Beach, CA
36)	04648	333	USS SAMUEL GOMPERS (AD-37)
37)	00181	303	Norfolk Naval Shipyard, Portsmouth, VA
38)	65888	301	Naval Aviation Depot, Naval Air Station, North Island, CA
39)	09111	299	Marine Aviation Logistics Squadron 11 (Rear), 3rd MAW, MCAS El Toro, CA
40)	48759	292	Naval Air Repair Activity Detachment, Kimhae, SK
41)	00383	289	Aviation Supply Office, Philadelphia, PA
42)	60087	277	Naval Air Station, Brunswick, ME
43)	68753	272	Naval Air Pacific Repair Activity Detachment, Singapore
44)	62770	271	Ship Repair Facility, Subic Bay, RP
45)	62254	269	Fleet Activities, Okinawa - Naval Air Facility, Kadena Air Force Base
46)	03366	265	USS AMERICA (CV-66)
47)	00151	264	Naval Shipyard, Philadelphia, PA
48)	00207	241	Naval Air Station, Jacksonville, FL
49)	03369	228	USS DWIGHT D. EISENHOWER (CVN-69)
50)	21118	227	USS MCKEE (AS-41)
51)	20748	216	USS PELELIU (LHA-5)
52)	00023	215	Naval Supply Systems Command Headquarters, Washington DC
53)	62995	214	Naval Air Station, Sigonella, IT
54)	00104	209	Ship's Parts Control Center, Mechanicsburg, PA
55)	93636	208	Marine Corps Logistics Depot Barstow, CA
56)	00191	207	Charleston Naval Shipyard, Charleston, SC
57)	65889	207	Naval Aviation Depot, Naval Air Station, Pensacola, FL
58)	63042	206	Naval Air Station, Lemoore, CA
59)	60191	203	Naval Air Station, Oceana, Virginia Beach, VA
60)	03359	194	USS FORRESTAL (CV-59)
61)	09808	192	Marine Aviation Logistics Squadron 39, Camp Pendleton, CA
62)	62863	191	Naval Station, Rota, SP
63)	00188	183	Naval Air Station, Norfolk, VA
64)	00275	181	Norfolk Naval Shipyard, Portsmouth, VA
65)	00102	179	Naval Shipyard, Portsmouth, NH
66)	03341	178	USS MIDWAY (CV-41)
67)	03368	173	USS NIMITZ (CVN-68)
68)	20132	171	USS DIXON (AS-37)
69)	62507	170	Naval Air Facility, Atsugi, JA

70)	03360	154	USS SARATOGA (CV-60)
71)	09114	154	Marine Aviation Logistics Squadron 14
72)	00158	139	Naval Air Station, Willow Grove, PA
73)	58HOZ	108	Army Troop Aviation Systems Command, Saint Louis, MO
74)	09116	103	Marine Aviation Logistics Squadron 16 (Rear), 3rd MAW, MCAS Tustin, CA
75)	07351	102	USS OKINAWA (LPH-3)

APPENDIX B. TOP SEVENTY-FIVE SAN DIEGO UNITS

	UIC	#IPGI Reqns	Activity
1)	65888	6,915	Naval Aviation Depot, NAS North Island, CA
2)	60258	2,853	Naval Shipyard, Long Beach, CA
3)	60259	2,795	Naval Air Station, Miramar, CA
4)	00246	1,747	Naval Air Station, North Island, CA
5)	63126	1,243	Pacific Missile Test Center, Point Mugu, CA
6)	63042	1,172	Naval Air Station, Lemoore, CA
7)	09124	1,155	Marine Aviation Logistics Squadron 24, Kanoehe, HI
8)	03366	938	USS AMERICA (CV-66)
9)	00188	852	Naval Air Station, Norfolk, VA
10)	03362	726	USS INDEPENDENCE (CV-62)
11)	62758	690	Ship Repair Facility, Yokosuka, JA
12)	60200	658	Naval Air Station, Cecil Field, Jacksonville, FL
13)	65886	652	Naval Aviation Depot, NAS Jacksonville, FL
14)	09112	594	Marine Aviation Logistics Squadron 12
15)	09111	590	Marine Aviation Logisitcs Squadron 11(Rear), 3rd MAW, MCAS El Toro, CA
16)	65923	564	Marine Aviation Depot, Cherry Pt, NC
17)	68251	519	Shore Intermediate Maintenance Activity, NavSta, Pearl Harbor, HI
18)	21297	510	USS ABRAHAM LINCOLN (CVN-72)
19)	00104	503	Ship's Parts Control Center, Mechanicsburg, PA
20)	03359	486	USS FORRESTAL (CV-59)
21)	09116	473	Marine Aviation Logistics Squadron 16(Rear), 3rd MAW, MCAS Tustin, CA
22)	62876	456	Naval Air Station, Cubi Point, RP
23)	00383	439	Aviation Supply Office, Philadelphia, PA
24)	09808	439	Marine Aviation Logistics Squadron 39, Camp Pendleton, CA
25)	65889	401	Naval Aviation Depot, NAS

			Pensacola, FL
26)	03369	393	USS DWIGHT D. EISENHOWER (CVN-69)
27)	00251	349	Puget Sound Naval Shipyard, Bremerton, WA
28)	03363	345	USS KITTY HAWK (CV-63)
29)	60191	334	Naval Air Station, Oceana, Virginia Beach, VA
30)	03360	330	USS SARATOGA (CV-60)
31)	00620	319	Naval Air Station, Whidbey Island, WA
32)	20132	314	USS DIXON (AS-37)
33)	21047	306	USS ACADIA (AD-42)
34)	61577	297	Naval Air Station, Guam, MI
35)	08810	287	USS JASON (AR-8)
36)	62995	277	Naval Air Station, Sigonella, IT
37)	00151	255	Naval Shipyard, Philadelphia, PA
38)	21387	254	USS ANTIETAM (CG-54)
39)	48758	253	Naval Air Pacific Repair Activity, Plant Reps Office, Atsugi, JA
40)	62791	239	Supervisor of Shipbuilding, Conversion & Repair USN, NavSta, San Diego, CA
41)	09131	235	Marine Aviation Logistics Squadron 31, Beaufort, SC
42)	65885	231	Naval Aviation Depot, NAS Alameda, CA
43)	62507	224	Naval Air Facility, Atsugi, JA
44)	00236	219	Naval Air Station, Alameda, CA
45)	00191	216	Charleston Naval Shipyard, Charleston, SC
46)	09136	210	Marine Aviation Logistics Squadron 36
47)	03361	204	USS RANGER (CV-61)
48)	00421	192	Naval Air Test Center, Patuxent River, MD
49)	07351	184	USS OKINAWA (LPH-3)
50)	60495	183	Naval Air Station, Fallon, NV
51)	45598	181	Ship Repair Facility Detachment, Sasebo, JA
52)	00334	178	Naval Air Station, Barbers Point, HI
53)	03341	177	USS MIDWAY (CV-41)
54)	60530	174	Naval Weapons Center, China Lake, CA
55)	00311	170	Pearl Harbor Naval Shipyard, Pearl Harbor, HI
56)	00204	165	Naval Air Station, Pensacola, FL
57)	52841	157	Marine Aviation Logistics Squadron 29, MCAS New River,

			Jacksonville, NC
58)	07184	152	USS JUNEAU (LPD-10)
59)	00215	151	Naval Air Station, Dallas, TX
60)	68828	145	Shore Intermediate Maintenance Activity, NavSta, Long Beach, CA
61)	66021	144	Naval Air Pacific Repair Activity, Atsugi, JA
62)	04629	141	USS PROTEUS (AS-19)
63)	09167	140	Marine Aviation Logistics Squadron 26, Jacksonville, NC
64)	20591	137	USS DAVID R. RAY (DD-971)
65)	21118	136	USS MCKEE (AS-41)
66)	03368	131	USS NIMITZ (CVN-68)
67)	00314	112	Submarine Base, Pearl Harbor, HI
68)	21447	106	USS PRINCETON (CG-59)
69)	00262	105	Marine Corps Air Facility, Quantico, VA
70)	62586	102	Ship Repair Facility, Guam, MI
71)	20587	101	USS ELLIOT (DD-967)
72)	21345	99	USS BUNKER HILL (CG-52)
73)	32770	98	Shore Intermediate Maintenance Activity, NavSta, Norfolk, VA
74)	68709	97	Naval Air Station, Mayport, FL
75)	00181	96	Norfolk Naval Shipyard, Portsmouth, VA

APPENDIX C. TOP ONE HUNDRED SHARPE UNITS

	UIC	#IPGI Reqns	Activity
1)	M93636	2932	TMO Marine Corps Logistics Depot, Barstow CA
2)	W80QJK	2262	177TH Armor Brigade, FT Irwin, CA
3)	W58HOZ	1575	Army Troop Aviation Systems Command, St Louis, MO
4)	W67G22	995	Consolidated Prop Act, Toole AFB, UT
5)	W61DEC	976	USA Intel Center, FT Huachuca, AZ
6)	W81P1F	897	FORSCOM Maint Fac FT Lewis, WA
7)	W25PVR	748	USA Petroleum Cntr, New Cumberland, PA
8)	WT4KD3	706	6th Spt Cntr, Taegu, SK
9)	W62G2Q	630	Consol Prop Office, Sacramento, CA
10)	W51HUU	590	GEN SPT SEC Maint DIV DIO, FT Carson, CO
11)	WT4J8P	551	702D Combat SPT BN STK REC ACCT Tongduchon, South Korea
12)	FB2049	547	Sacramento ALC TIDS, McClellan AFB, CA
13)	W68NE3	503	HHC 181ST SPT BN Seattle, WA
14)	W81H4F	486	CO B Minus MAINT 495TH CSMS, Helena, MT
15)	FB5205	471	432 TTW LGS Misawa AB, Honshu JA
16)	FB5294	462	52 RMG LGS Osan AB South Korea
17)	W45G18	432	Consol Prop Off Texarkana, TX
18)	FB5270	420	19 SUPS LGS Kadena AB JA
19)	W800DG	377	ECS 16 CL IX Los Alamitos, CA
20)	W81E2A	360	Ship Depot for Automatic Return
21)	FB5284	358	8 TFW LGS Kunsan AB South Korea
22)	W31G1Y	354	Consol Prop Off Anniston AL
23)	WT4HAF	344	USA MAT SPT CEN, Waegwan SK
24)	W51WKX	344	C CO 3RD BN 68TH Armor FT Carson, CO
25)	WC1JT5	328	DOL FT Richardson, AK
26)	W81M3U	321	NTC FT Irwin, CA
27)	M28341	320	TMO Camp Pendleton CA
28)	W81APM	310	Comm Elect. Contr. Off. Far East, Gumi, SK
29)	W25G1Q	308	Consol Prop Office Chambersburg, PA
30)	W81LG1	296	Installation SPT UNIT CL IX, Camp Roberts, CA
31)	M94700	287	TMO Marine Corps Logistics Depot, Albany, GA
32)	W22GLF	274	DOL, FT Knox, KY
33)	W62KNE	267	Vehicle Maint., FT Ord CA

34)	W81AEC	264	Tactical Wheeled Vehicles Off. Far East, Chang Won, SK
35)	WX3JP5	245	SPT CMD Schofield Barracks, HI
36)	WK4NP7	242	Mainz Army Depot, Mainz GR
37)	W81P1R	241	FORSCOM Maint Facility FT Polk, LA
38)	FB5240	222	633 ABW LGS Anderson AB, Guam
39)	W61DEB	220	USA INTEL CNTR, FT Huachuca, AZ
40)	W33RQN	210	Auto Shop #1, FT Benning, GA
41)	FB4427	208	60 SUPS - LGSCD Travis AFB, CA
42)	M62204	207	RMD, MCLB Barstow, CA
43)	M67004	201	Comptroller, MCLB Albany, GA
44)	W80TWD	200	NTC SSA FWD, FT Irwin CA
45)	W25G1V	197	Consol Prop Officer, Tobyhanna, PA
46)	W80ECQ	197	M113 Cont Mgmt Off. Far East, Chang Won, SK
47)	W62M5F	194	340th CS BN, Schofield Barracks, HI
48)	W801YL	194	TMP, Starke, FL
49)	W44DUC	190	DOL, FT Sill, OK
50)	N00246	189	Naval Air Station North Island, San Diego, CA
51)	W45QML	187	DOL, FT Bliss, TX
52)	WX3JJW	184	725th CS BN, Schofield Barracks, HI
53)	W42SU8	184	HHC 1ST BN 70th AR, FT Polk, LA
54)	W80MWE	183	31st Maint. Co. FT Irwin, CA
55)	FB5209	180	374 AW LGS Yokota AB, Honshu, JA
56)	W62SN6	179	HHC 127th SIG BN, FT Ord, CA
57)	W62TL1	178	707th CS BN FT Ord, CA
58)	FB6471	176	Asst. USPFO for Prop. Fairchild AFB, WA
59)	W805LM	175	USA INTEL CNTR, FT Huachuca, AZ
60)	WC1JU4	168	23rd ENGR CO, FT Richardson, AK
61)	W68VMM	165	99th SPT BN, FT Lewis, WA
62)	W62M5G	163	123rd CS CO MATES, FT Irwin, CA
63)	W81JME	161	3666th CS CO, Phoenix, AZ
64)	FB5000	158	3rd LGS Elmendorf, AFB, AK
65)	M95000	157	LG LGS 3 Elmendorf AFB, AK
66)	FB4672	156	93 SUPS, Castle AFB, CA
67)	W34GM2	155	DOL, FT Campbell, KY
68)	W45N7V	155	Corpus Christi Army Depot Corpus Christi, TX
69)	WT4KD8	154	CO A 3RD BN 501ST AVN, Pyongtaek, South Korea
70)	FB4479	153	62 MAW LGS McChord AFB, WA
71)	FB2027	150	00-ALC TID Hill AFB, UT
72)	FB6041	149	California Air Nat'l Guard Base, NAS Moffett Field, CA
73)	WX3V9U	149	25th AVN CO. Schofield Barracks, HI
74)	W81AT0	144	219th CBT SPT BN, Leghorn, IT
75)	W15GK8	143	DMM FT Monmouth, NJ
76)	R09111	139	MALS 11, Santa Ana, CA
77)	W67K3F	139	115th CS CO, Draper, UT

78)	W81EU8	139	USA Material Support Cntr, Waegwan, SK
79)	WT4GLR	138	501st AVN REGT PBO Pyongtaek, SK
80)	W81HOW	130	CO B 145th SPT BN, Boise, ID
81)	W45CA1	128	90th ARCOM, FT Sam Houston, TX
82)	R09808	127	MALS 39, Camp Pendleton, CA
83)	FB6042	125	163rd LGS, March AFB, CA
84)	W68PPA	124	85th CS CO, FT Lewis, WA
85)	W61DB9	123	S&S Whse, FT Huachuaca, AZ
86)	FB4852	121	57th SUP SQ Nellis AFB, NV
87)	W45CMN	120	4005th USAG, FT Hood, TX
88)	W55XGH	114	CEGSWA, Doha, Kuwait
89)	W81RLH	112	Fielding Team M88 CEV AVLB, FT Stewart, GA
90)	WK9E2Y	109	8th Log Command, Leghorn, IT
91)	W5CR5E	107	Consol Maint DIV, FT McCoy, WI
92)	W55XGG	106	CEGSWA, Doha, Kuwait
93)	W80TWT	105	177th SUP BN, FT Irwin, CA
94)	W36RXL	103	782nd Maint BN, FT Bragg, NC
95)	WK4R30	99	14th CBT EquipmentCO, Moenchengladbach, GER
96)	W81N6P	98	1113th Trans CO, Sacremento, CA
97)	W42UV6	94	FOMS NO 5, Pineville, LA
98)	W31NWY	78	Aircraft Maint Contract, FT Rucker, AL
99)	W68RZ2	66	99th SPT BN, FT Lewis, WA
100)	W31BMW	49	Aircraft Maint Contract 3, FT Rucker, AL

APPENDIX D. FOUR-COLUMN WIRE DIAGRAM OUTPUT

FILE: OAKLAND DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
0	.00	478096.37	4385
10	.00	451994.83	-4577
20	.00	276311.55	-11947
30	.00	151324.62	-16495
40	.00	56219.01	-19617
50	.00	-65310.56	-22151
60	.00	-173234.43	-24111
70	.00	-261597.80	-25611
80	.00	-328436.96	-26807
90	.00	-404428.59	-27845
100	.00	-469750.52	-28757
0	.01	1619067.01	2843
10	.01	1386529.67	-6865
20	.01	1090325.67	-14395
30	.01	873236.48	-18899
40	.01	684864.99	-22025
50	.01	486059.05	-24513
60	.01	287921.63	-26331
70	.01	171709.90	-27687
80	.01	21873.43	-28889
90	.01	-50818.48	-29791
100	.01	-160208.37	-30741
0	.02	1534768.79	407
10	.02	1193094.18	-10001
20	.02	873514.93	-17379
30	.02	672103.02	-21549
40	.02	439139.13	-24837
50	.02	251244.38	-27027
60	.02	134066.22	-28547
70	.02	27441.49	-29829
80	.02	-110601.48	-31011
90	.02	-284021.87	-32019
100	.02	-455084.06	-33007
0	.03	1094447.79	-2237
10	.03	795340.01	-12915
20	.03	424378.30	-20421
30	.03	231271.17	-24225
40	.03	9136.52	-27309
50	.03	-191161.61	-29489
60	.03	-444238.03	-31549
70	.03	-565889.32	-32445
80	.03	-666048.22	-33205
90	.03	-738849.96	-33781
100	.03	-807131.77	-34401
0	.04	313591.16	-5435
10	.04	-20300.41	-16609
20	.04	-250937.32	-22931
30	.04	-481075.81	-27225
40	.04	-817201.38	-30925
50	.04	-933865.96	-32163
60	.04	-1019331.38	-33049
70	.04	-1099701.47	-33783
80	.04	-1177631.72	-34403
90	.04	-1243835.56	-34909
100	.04	-1333585.15	-35345
0	.05	974039.65	-7085
10	.05	377498.29	-19501
20	.05	-95922.66	-26025
30	.05	-628667.74	-31281
40	.05	-918897.21	-32771
50	.05	-1088066.58	-33773
60	.05	-1251310.87	-34545
70	.05	-1376552.35	-35173
80	.05	-1562371.77	-35685
90	.05	-1736947.15	-36111
100	.05	-1833363.50	-36415
0	.06	-1807078.07	-12975
10	.06	-2039008.70	-22857
20	.06	-2501070.08	-31341
30	.06	-2567342.35	-32985

FILE: OAKLAND DATA A1

40	.06	-2614095.40	-33985
50	.06	-2676722.27	-34887
60	.06	-2734030.02	-35577
70	.06	-2785735.65	-36117
80	.06	-2819413.18	-36481
90	.06	-2863410.71	-36845
100	.06	-2908291.92	-37167
0	.07	-1408815.91	-14361
10	.07	-1744528.41	-25797
20	.07	-2072866.88	-32263
30	.07	-2145987.11	-33715
40	.07	-2229616.51	-34839
50	.07	-2312953.54	-35707
60	.07	-2381397.07	-36315
70	.07	-2433233.47	-36735
80	.07	-2509770.90	-37199
90	.07	-2587707.60	-37603
100	.07	-2700896.06	-38077
0	.08	-991942.00	-15829
10	.08	-1510473.38	-30203
20	.08	-1664423.35	-33269
30	.08	-1784135.56	-34793
40	.08	-1912908.17	-35945
50	.08	-2004106.56	-36621
60	.08	-2112750.97	-37233
70	.08	-2263878.36	-37879
80	.08	-2390384.39	-38363
90	.08	-2492848.30	-38721
100	.08	-2583912.54	-39003
0	.09	-569677.84	-17387
10	.09	-1123003.73	-31943
20	.09	-1350355.58	-34811
30	.09	-1551085.74	-36345
40	.09	-1773849.08	-37441
50	.09	-2014755.66	-38337
60	.09	-2179361.38	-38863
70	.09	-2372292.16	-39357
80	.09	-2507100.08	-39665
90	.09	-2658108.12	-39973
100	.09	-2753048.62	-40153
0	.10	-157179.16	-19255
10	.10	-958087.71	-34811
20	.10	-1653366.61	-38111
30	.10	-2155127.10	-39429
40	.10	-2545432.94	-40149
50	.10	-2932273.42	-40683
60	.10	-3270582.63	-41057
70	.10	-3620967.42	-41377
80	.10	-3886960.23	-41581
90	.10	-4132133.47	-41745
100	.10	-4271639.19	-41839

FILE: SANDIEGO DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
00	.00	369508	9316
10	.00	439298	4852
20	.00	414510	720
30	.00	398740	-2094
40	.00	397300	-4056
50	.00	374568	-5692
60	.00	365701	-7034
70	.00	356998	-8062
80	.00	342621	-8920
90	.00	333011	-9752
100	.00	314694	-10562
00	.01	1441262	8736
10	.01	1394704	3812
20	.01	1295934	-506
30	.01	1234776	-3352
40	.01	1155379	-5386
50	.01	1089638	-7056
60	.01	1020001	-8328
70	.01	987556	-9334
80	.01	942858	-10278
90	.01	878839	-11118
100	.01	838130	-11806
00	.02	1908551	7590
10	.02	1812493	2272
20	.02	1677018	-2090
30	.02	1566151	-4934
40	.02	1448990	-7150
50	.02	1374176	-8646
60	.02	1291540	-9884
70	.02	1219051	-10938
80	.02	1125388	-11948
90	.02	1007140	-12800
100	.02	918239	-13516
00	.03	2063637	6190
10	.03	1972057	524
20	.03	1799930	-4000
30	.03	1670983	-6804
40	.03	1561885	-8912
50	.03	1447035	-10532
60	.03	1266187	-12152
70	.03	1177809	-12972
80	.03	1114115	-13592
90	.03	1030576	-14144
100	.03	959654	-14720
00	.04	1751340	4362
10	.04	1630415	-1692
20	.04	1506634	-5922
30	.04	1364288	-8956
40	.04	1170421	-11542
50	.04	1096367	-12608
60	.04	1019631	-13482
70	.04	944176	-14186
80	.04	888602	-14748
90	.04	821360	-15308
100	.04	779786	-15734
00	.05	2440582	3504
10	.05	2130523	-3584
20	.05	1795868	-8142
30	.05	1420560	-11884
40	.05	1178067	-13162
50	.05	1006290	-14106
60	.05	872237	-14866
70	.05	659818	-15496
80	.05	490409	-16082
90	.05	350021	-16546
100	.05	286005	-16932
00	.06	256255	-396
10	.06	144266	-6320
20	.06	-148139	-12154
30	.06	-181007	-13448

40	.06	-217215	-14426
50	.06	-266534	-15292
60	.06	-320073	-16008
70	.06	-364840	-16556
80	.06	-406992	-17010
90	.06	-459302	-17450
100	.06	-510401	-17836
00	.07	697822	-1258
10	.07	517655	-8332
20	.07	315895	-12828
30	.07	259099	-14172
40	.07	185866	-15278
50	.07	108556	-16146
60	.07	35585	-16822
70	.07	-38704	-17388
80	.07	-109472	-17860
90	.07	-185810	-18290
100	.07	-263560	-18676
00	.08	1163362	-2096
10	.08	857075	-11294
20	.08	752704	-13708
30	.08	635850	-15272
40	.08	510830	-16424
50	.08	392672	-17264
60	.08	293637	-17866
70	.08	157052	-18502
80	.08	33154	-19004
90	.08	-107589	-19492
100	.08	-216703	-19846
00	.09	1634814	-3000
10	.09	1282443	-12674
20	.09	1072636	-15320
30	.09	846831	-16984
40	.09	644366	-18040
50	.09	405892	-18960
60	.09	198897	-19624
70	.09	-34143	-20244
80	.09	-237526	-20702
90	.09	-481488	-21172
100	.09	-652378	-21476
00	.10	2092005	-4244
10	.10	1415773	-15638
20	.10	724352	-18812
30	.10	35536	-20494
40	.10	-481160	-21446
50	.10	-954894	-22102
60	.10	-1423817	-22606
70	.10	-1817930	-22980
80	.10	-2233058	-23302
90	.10	-2503282	-23502
100	.10	-2798513	-23684

FILE: NADEPAL DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
00	.00	85904	202
10	.00	53809	-1450
20	.00	-14774	-2776
30	.00	-63054	-3576
40	.00	-119407	-4174
50	.00	-161748	-4644
60	.00	-218484	-5046
70	.00	-248600	-5328
80	.00	-270966	-5528
90	.00	-303750	-5720
100	.00	-322553	-5852
00	.01	134532	-306
10	.01	15038	-2186
20	.01	-90739	-3502
30	.01	-163021	-4304
40	.01	-228725	-4862
50	.01	-276436	-5304
60	.01	-333063	-5626
70	.01	-360733	-5858
80	.01	-391215	-6044
90	.01	-401075	-6152
100	.01	-427833	-6306
00	.02	-59174	-1186
10	.02	-185621	-3130
20	.02	-258580	-4264
30	.02	-305140	-4924
40	.02	-358513	-5474
50	.02	-393015	-5804
60	.02	-412210	-6018
70	.02	-427340	-6196
80	.02	-449461	-6352
90	.02	-493519	-6514
100	.02	-517154	-6642
00	.03	-224242	-1940
10	.03	-310624	-3774
20	.03	-387819	-4900
30	.03	-419966	-5422
40	.03	-451168	-5852
50	.03	-484715	-6168
60	.03	-531479	-6504
70	.03	-548538	-6606
80	.03	-559431	-6688
90	.03	-568383	-6734
100	.03	-576423	-6774
00	.04	-383466	-2670
10	.04	-465843	-4480
20	.04	-497632	-5274
30	.04	-532066	-5842
40	.04	-592433	-6440
50	.04	-611764	-6604
60	.04	-620036	-6682
70	.04	-631891	-6758
80	.04	-634394	-6798
90	.04	-638534	-6838
100	.04	-654684	-6888
00	.05	-353853	-3040
10	.05	-452087	-4868
20	.05	-512753	-5704
30	.05	-594134	-6500
40	.05	-617383	-6660
50	.05	-628465	-6754
60	.05	-638224	-6822
70	.05	-643808	-6868
80	.05	-657587	-6924
90	.05	-666667	-6950
100	.05	-669781	-6980
00	.06	-637345	-4044
10	.06	-670061	-5272
20	.06	-744046	-6508
30	.06	-751714	-6672

FILE: NADEPAL DATA A1

40	.06	-757306	-6772
50	.06	-762754	-6848
60	.06	-766794	-6900
70	.06	-772334	-6952
80	.06	-775978	-6986
90	.06	-779705	-7016
100	.06	-781939	-7036
00	.07	-614512	-4252
10	.07	-661692	-5698
20	.07	-710843	-6586
30	.07	-720465	-6748
40	.07	-726531	-6834
50	.07	-733885	-6910
60	.07	-740160	-6964
70	.07	-745825	-7006
80	.07	-749734	-7034
90	.07	-754487	-7062
100	.07	-762191	-7096
00	.08	-588993	-5886
10	.08	-666106	-6410
20	.08	-681244	-6696
30	.08	-690697	-6822
40	.08	-702835	-6930
50	.08	-711005	-6990
60	.08	-717137	-7030
70	.08	-728153	-7080
80	.08	-735013	-7110
90	.08	-743577	-7140
100	.08	-749306	-7160
00	.09	-562394	-4712
10	.09	-635473	-6546
20	.09	-656239	-6820
30	.09	-675028	-6964
40	.09	-688536	-7040
50	.09	-702675	-7098
60	.09	-716206	-7144
70	.09	-732025	-7186
80	.09	-738741	-7204
90	.09	-747874	-7224
100	.09	-758459	-7244
00	.10	-537878	-5008
10	.10	-625672	-6820
20	.10	-669588	-7060
30	.10	-705186	-7168
40	.10	-741066	-7236
50	.10	-777549	-7290
60	.10	-812288	-7326
70	.10	-838749	-7352
80	.10	-863197	-7374
90	.10	-880816	-7388
100	.10	-894504	-7400

FILE: NADEPNI DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
00	.00	31167	296
10	.00	25307	-606
20	.00	360	-1438
30	.00	-12406	-1882
40	.00	-25164	-2196
50	.00	-37292	-2478
60	.00	-50163	-2698
70	.00	-62627	-2854
80	.00	-69858	-2968
90	.00	-73817	-3056
100	.00	-79686	-3134
00	.01	75177	200
10	.01	53794	-780
20	.01	25677	-1602
30	.01	2582	-2080
40	.01	-15281	-2400
50	.01	-32344	-2680
60	.01	-44782	-2870
70	.01	-50610	-2986
80	.01	-59214	-3098
90	.01	-67407	-3188
100	.01	-84604	-3290
00	.02	73268	20
10	.02	43970	-1024
20	.02	15137	-1838
30	.02	-10969	-2292
40	.02	-33205	-2650
50	.02	-47976	-2886
60	.02	-59417	-3040
70	.02	-71047	-3170
80	.02	-84691	-3290
90	.02	-100810	-3406
100	.02	-117258	-3500
00	.03	54502	-200
10	.03	25018	-1308
20	.03	-11011	-2108
30	.03	-33752	-2546
40	.03	-54208	-2888
50	.03	-74250	-3122
60	.03	-104789	-3362
70	.03	-111123	-3440
80	.03	-115460	-3494
90	.03	-123942	-3540
100	.03	-128649	-3588
00	.04	39757	-442
10	.04	2351	-1642
20	.04	-24889	-2348
30	.04	-53323	-2838
40	.04	-89580	-3250
50	.04	-100857	-3374
60	.04	-107415	-3460
70	.04	-116275	-3526
80	.04	-120217	-3568
90	.04	-125376	-3612
100	.04	-131194	-3638
00	.05	51508	-612
10	.05	-3300	-1934
20	.05	-43781	-2654
30	.05	-88329	-3250
40	.05	-102913	-3390
50	.05	-111747	-3480
60	.05	-118138	-3552
70	.05	-128087	-3602
80	.05	-133756	-3642
90	.05	-134959	-3662
100	.05	-136356	-3676
00	.06	-10251	-1124
10	.06	-36614	-2204
20	.06	-94879	-3220
30	.06	-101591	-3364

FILE: NADEPNI DATA A1

40	.06	-108038	-3470
50	.06	-115567	-3560
60	.06	-121663	-3622
70	.06	-123978	-3652
80	.06	-126236	-3676
90	.06	-127901	-3694
100	.06	-131241	-3718
00	.07	-205	-1250
10	.07	-39709	-2544
20	.07	-81253	-3300
30	.07	-89450	-3440
40	.07	-99437	-3556
50	.07	-107786	-3634
60	.07	-111214	-3668
70	.07	-112401	-3684
80	.07	-118256	-3720
90	.07	-127550	-3764
100	.07	-132031	-3786
00	.08	11288	-1406
10	.08	-55088	-3122
20	.08	-69386	-3390
30	.08	-83148	-3550
40	.08	-93492	-3642
50	.08	-98563	-3682
60	.08	-105479	-3722
70	.08	-116507	-3772
80	.08	-123280	-3800
90	.08	-130143	-3824
100	.08	-139380	-3852
00	.09	22055	-1604
10	.09	-44998	-3272
20	.09	-68133	-3552
30	.09	-81757	-3662
40	.09	-91609	-3716
50	.09	-109206	-3790
60	.09	-122957	-3834
70	.09	-134747	-3866
80	.09	-144806	-3890
90	.09	-157028	-3916
100	.09	-158793	-3922
00	.10	29232	-1870
10	.10	-49131	-3502
20	.10	-94076	-3754
30	.10	-129524	-3858
40	.10	-151672	-3908
50	.10	-169491	-3940
60	.10	-187659	-3964
70	.10	-203148	-3982
80	.10	-224088	-4002
90	.10	-240075	-4016
100	.10	-244090	-4022

FILE: MINSY DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
00	.00	11508	21
10	.00	5740	-487
20	.00	-1150	-845
30	.00	-8216	-1091
40	.00	-13389	-1243
50	.00	-19879	-1371
60	.00	-26825	-1477
70	.00	-30989	-1533
80	.00	-32809	-1571
90	.00	-35992	-1617
100	.00	-37144	-1643
00	.01	20496	-35
10	.01	13106	-557
20	.01	4102	-933
30	.01	-5460	-1171
40	.01	-15060	-1335
50	.01	-21744	-1457
60	.01	-28029	-1541
70	.01	-29617	-1579
80	.01	-37804	-1633
90	.01	-42838	-1681
100	.01	-46500	-1721
00	.02	27349	-73
10	.02	16655	-613
20	.02	-2306	-1043
30	.02	-12835	-1263
40	.02	-26473	-1445
50	.02	-33760	-1549
60	.02	-35843	-1593
70	.02	-40409	-1651
80	.02	-49210	-1715
90	.02	-56105	-1761
100	.02	-59899	-1789
00	.03	21094	-137
10	.03	5451	-725
20	.03	-15410	-1171
30	.03	-24605	-1367
40	.03	-33999	-1529
50	.03	-41871	-1615
60	.03	-55923	-1737
70	.03	-57729	-1761
80	.03	-59890	-1785
90	.03	-63141	-1809
100	.03	-64809	-1825
00	.04	15762	-249
10	.04	-5214	-885
20	.04	-18302	-1249
30	.04	-33421	-1503
40	.04	-51504	-1699
50	.04	-54373	-1733
60	.04	-58012	-1773
70	.04	-60207	-1797
80	.04	-62714	-1819
90	.04	-64896	-1835
100	.04	-67492	-1853
00	.05	12223	-357
10	.05	-11274	-1015
20	.05	-27526	-1389
30	.05	-48941	-1687
40	.05	-53555	-1739
50	.05	-60042	-1783
60	.05	-62814	-1811
70	.05	-65282	-1831
80	.05	-67378	-1849
90	.05	-69968	-1867
100	.05	-70990	-1875
00	.06	-3774	-553
10	.06	-20934	-1153
20	.06	-53819	-1701
30	.06	-56026	-1747

FILE: MINSY DATA A1

40	.06	-57836	-1777
50	.06	-61364	-1815
60	.06	-64301	-1841
70	.06	-66327	-1857
80	.06	-68340	-1871
90	.06	-69839	-1881
100	.06	-72163	-1893
00	.07	-9075	-673
10	.07	-30866	-1355
20	.07	-51628	-1721
30	.07	-54785	-1771
40	.07	-58390	-1811
50	.07	-62169	-1843
60	.07	-66109	-1869
70	.07	-67136	-1877
80	.07	-70771	-1895
90	.07	-73512	-1907
100	.07	-73790	-1909
00	.08	-8912	-749
10	.08	-44595	-1643
20	.08	-51070	-1757
30	.08	-55185	-1805
40	.08	-61459	-1853
50	.08	-64485	-1873
60	.08	-69496	-1897
70	.08	-72252	-1909
80	.08	-73897	-1915
90	.08	-76958	-1925
100	.08	-78214	-1929
00	.09	-9803	-845
10	.09	-45253	-1715
20	.09	-53693	-1811
30	.09	-60619	-1861
40	.09	-67846	-1897
50	.09	-73076	-1917
60	.09	-77427	-1921
70	.09	-79682	-1935
80	.09	-82055	-1941
90	.09	-84359	-1947
100	.09	-85094	-1949
00	.10	-12924	-991
10	.10	-52308	-1807
20	.10	-69033	-1901
30	.10	-77043	-1929
40	.10	-80118	-1937
50	.10	-82055	-1943
60	.10	-85263	-1951
70	.10	-88692	-1955
80	.10	-97246	-1963
90	.10	-97176	-1963
100	.10	-102668	-1967

FILE: LBNSY DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
00	.00	10444	44
10	.00	5027	-470
20	.00	-2980	-870
30	.00	-13146	-1178
40	.00	-18644	-1346
50	.00	-24803	-1488
60	.00	-32802	-1608
70	.00	-37289	-1686
80	.00	-41603	-1750
90	.00	-44401	-1792
100	.00	-48315	-1838
00	.01	19799	8
10	.01	10499	-520
20	.01	-1143	-958
30	.01	-12016	-1250
40	.01	-19853	-1424
50	.01	-28022	-1574
60	.01	-34132	-1672
70	.01	-41051	-1756
80	.01	-46124	-1806
90	.01	-50886	-1856
100	.01	-55635	-1898
00	.02	23026	-48
10	.02	11911	-614
20	.02	-3612	-1048
30	.02	-16169	-1340
40	.02	-26077	-1526
50	.02	-34343	-1660
60	.02	-42577	-1766
70	.02	-50017	-1836
80	.02	-58619	-1904
90	.02	-63123	-1938
100	.02	-72356	-1990
00	.03	19393	-122
10	.03	8007	-702
20	.03	-11005	-1170
30	.03	-22776	-1444
40	.03	-34438	-1648
50	.03	-47677	-1798
60	.03	-66345	-1944
70	.03	-68281	-1966
80	.03	-69865	-1982
90	.03	-71942	-1996
100	.03	-73096	-2006
00	.04	18329	-190
10	.04	399	-856
20	.04	-18256	-1322
30	.04	-34940	-1618
40	.04	-62952	-1920
50	.04	-66014	-1950
60	.04	-68193	-1974
70	.04	-69085	-1986
80	.04	-70365	-1998
90	.04	-74461	-2016
100	.04	-74754	-2020
00	.05	14133	-300
10	.05	-6364	-992
20	.05	-29827	-1478
30	.05	-65133	-1912
40	.05	-68675	-1954
50	.05	-71210	-1980
60	.05	-73005	-1996
70	.05	-74203	-2008
80	.05	-75994	-2022
90	.05	-76376	-2026
100	.05	-77287	-2032
00	.06	-208	-462
10	.06	-19519	-1158
20	.06	-64927	-1902
30	.06	-67787	-1950

FILE: LBNSY DATA A1

40	.06	-69437	-1974
50	.06	-71439	-1996
60	.06	-72638	-2008
70	.06	-74768	-2024
80	.06	-74832	-2026
90	.06	-76600	-2036
100	.06	-77213	-2040
00	.07	-5067	-574
10	.07	-34943	-1418
20	.07	-64751	-1930
30	.07	-67049	-1966
40	.07	-70152	-1998
50	.07	-71073	-2008
60	.07	-73597	-2026
70	.07	-75351	-2036
80	.07	-75957	-2040
90	.07	-77221	-2046
100	.07	-78153	-2050
00	.08	-9276	-686
10	.08	-59060	-1860
20	.08	-64440	-1954
30	.08	-68395	-1996
40	.08	-70107	-2012
50	.08	-73331	-2032
60	.08	-74260	-2038
70	.08	-76584	-2048
80	.08	-78214	-2054
90	.08	-78813	-2056
100	.08	-80626	-2062
00	.09	-14607	-834
10	.09	-60393	-1920
20	.09	-66368	-1992
30	.09	-71445	-2028
40	.09	-73141	-2038
50	.09	-76642	-2052
60	.09	-77759	-2056
70	.09	-80530	-2064
80	.09	-80410	-2064
90	.09	-81155	-2066
100	.09	-81045	-2066
00	.10	-21750	-1030
10	.10	-64994	-1986
20	.10	-73817	-2042
30	.10	-77162	-2056
40	.10	-78160	-2060
50	.10	-84873	-2070
60	.10	-85654	-2072
70	.10	-88249	-2074
80	.10	-88179	-2074
90	.10	-88109	-2074
100	.10	-91986	-2076

FILE: SHARPE DATA A1

FLAT SHCG	PCNT SHCG	COST DLTA	NSN DLTA
00	.00	106136	-4145
10	.00	-30572	-11969
20	.00	-176829	-17421
30	.00	-284292	-20487
40	.00	-379715	-22535
50	.00	-458719	-24015
60	.00	-519839	-25097
70	.00	-570523	-25875
80	.00	-625414	-26567
90	.00	-675507	-27111
100	.00	-711307	-27523
00	.01	228195	-5627
10	.01	17604	-13805
20	.01	-191281	-19251
30	.01	-339567	-22259
40	.01	-453717	-24219
50	.01	-552261	-25607
60	.01	-625966	-26569
70	.01	-683225	-27309
80	.01	-738844	-27865
90	.01	-777689	-28225
100	.01	-827987	-28607
00	.02	99738	-7613
10	.02	-159153	-16345
20	.02	-382545	-21523
30	.02	-543374	-24309
40	.02	-659362	-26135
50	.02	-780478	-27499
60	.02	-857536	-28289
70	.02	-930622	-28881
80	.02	-980194	-29245
90	.02	-1006402	-29441
100	.02	-1030859	-29621
00	.03	-47784	-9997
10	.03	-356927	-19073
20	.03	-565004	-23855
30	.03	-757968	-26803
40	.03	-884420	-28279
50	.03	-950339	-28953
60	.03	-989068	-29295
70	.03	-1020256	-29535
80	.03	-1042624	-29717
90	.03	-1065362	-29879
100	.03	-1086565	-29997
00	.04	-250157	-12741
10	.04	-555507	-21813
20	.04	-799319	-26593
30	.04	-953322	-28655
40	.04	-993106	-29149
50	.04	-1038815	-29555
60	.04	-1068486	-29779
70	.04	-1101079	-29985
80	.04	-1120577	-30125
90	.04	-1147540	-30231
100	.04	-1179899	-30319
00	.05	-526848	-15243
10	.05	-853552	-24917
20	.05	-1080284	-28763
30	.05	-1117051	-29295
40	.05	-1163537	-29771
50	.05	-1193649	-30021
60	.05	-1216537	-30195
70	.05	-1241763	-30343
80	.05	-1264210	-30453
90	.05	-1287237	-30555
100	.05	-1310565	-30643
00	.06	-523174	-17155
10	.06	-963495	-27925
20	.06	-1079390	-29455
30	.06	-1148971	-29997

FILE: SHARPE DATA A1

40	.06	-1199863	-30299
50	.06	-1243694	-30505
60	.06	-1275952	-30627
70	.06	-1306857	-30725
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100	.06	-1390555	-30947
00	.07	-972930	-22281
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20	.07	-1567423	-30435
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50	.09	-2172340	-31499
60	.09	-2186924	-31513
70	.09	-2194234	-31519
80	.09	-2197143	-31521
90	.09	-2203297	-31525
100	.09	-2203171	-31525
00	.10	-2321729	-31549
10	.10	-2321848	-31551
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70	.10	-2321867	-31551
80	.10	-2321870	-31551
90	.10	-2321873	-31551
100	.10	-2321876	-31551

APPENDIX E. DETAILED OUTPUT BY NSN

OBS	NSN	_TYPE_	_FREQ_	UPRICE	ANNUALD	NUMREQNS	EOQR
1		0	7500	8557941.10	1160879	25165	816969
2	2995000764302	1	1	4.40	172	140	82
3	5330010154717	1	1	46.42	125	108	22
4	3110008907986	1	1	25.50	196	94	37
5	4820011326893	1	1	45.21	124	70	22
6	1620002857031	1	1	5780.00	69	69	2
7	2840000158540	1	1	3050.00	66	66	2
8	2840010491153	1	1	1300.00	65	65	3
9	2995000753885	1	1	17.50	66	62	26
10	2995012025196	1	1	179.98	120	61	11
11	1660008335126	1	1	90.00	178	57	19
12	4820011227965	1	1	58.00	60	57	13
13	3020005035045	1	1	461.70	68	56	5
14	3110004452597	1	1	47.32	140	55	23
15	2840009383840	1	1	1300.00	54	54	3
16	2995000753878	1	1	5.60	58	53	42
17	4810013177805	1	1	162.00	72	53	9
18	4730013117817	1	1	223.00	70	51	7
19	5330000762293	1	1	43.50	178	51	27
20	2995000764299	1	1	117.98	161	50	15
21	4810012230014	1	1	51.00	58	49	14
22	2835005557414	1	1	2450.00	48	48	2
23	2995000753872	1	1	8.10	48	47	32
24	4810000753874	1	1	12.00	47	47	26
25	4810010303693	1	1	34.90	63	47	18
26	4820000753876	1	1	9.50	48	45	30
27	1660008214635	1	1	126.19	53	44	9
28	4810004681390	1	1	13.69	46	44	24
29	2995010295263	1	1	160.77	46	43	7
30	4820000753880	1	1	5.60	46	43	38
31	6105010484582	1	1	1111.93	45	43	3
32	5310009389539	1	1	159.00	59	41	8
33	3110010542631	1	1	55.17	154	40	22
34	2805003951386	1	1	18.50	104	38	31
35	2840011302736	1	1	33.50	40	38	14
36	2925004451511	1	1	431.00	42	38	4
37	3020000227837	1	1	94.04	153	38	17
38	3110007691025	1	1	0.01	119	37	1439
39	5340004799235	1	1	1.03	63	37	103
40	5330011048196	1	1	279.00	92	36	8
41	2840011807760	1	1	91.00	37	35	8
42	2840000600042	1	1	1600.00	40	34	2
43	2925009228890	1	1	300.22	40	34	5
44	1650003690224	1	1	87.00	64	33	11
45	2910004973410	1	1	47.98	101	33	19
46	2995005000182	1	1	798.00	37	33	3
47	3020004160064	1	1	87.77	54	33	10
48	4730000753877	1	1	4.40	36	33	38
49	4810008350271	1	1	4.68	35	32	36
50	4810008350276	1	1	18.54	42	32	20
51	2835009082532	1	1	115.00	31	31	7
52	2910002562796	1	1	55.10	31	31	10
53	2910009625825	1	1	11.04	59	31	30
54	3110006081550	1	1	3.62	51	31	49
55	3120008083046	1	1	71.00	110	31	16
56	5930010501206	1	1	375.00	36	31	4
57	1660003852477	1	1	136.00	30	30	6
58	2910002312522	1	1	81.35	30	30	8
59	4810004424550	1	1	74.05	57	30	12
60	4810008350280	1	1	14.71	36	30	21
61	1620002762963	1	1	7180.00	29	29	1
62	4710000753870	1	1	4.20	29	29	35
63	6135010503193	1	1	8.70	44	29	30
64	1650003374798	1	1	14.21	37	28	21
65	2835009082533	1	1	3.70	56	28	51
66	2910002348455	1	1	9.70	28	28	22
67	2995004839485	1	1	34.50	31	28	13
68	5330000598827	1	1	0.59	240	28	266
69	1650008913392	1	1	54.00	43	27	12
70	2835001047379	1	1	372.00	89	27	6
71	2925009609850	1	1	1220.00	27	27	2
72	3120008083045	1	1	88.00	84	27	13
73	5330002489417	1	1	98.74	32	27	8
74	5330004000673	1	1	3.99	40	27	42
75	5330005850386	1	1	0.01	91	27	1258

OBS	NSN	_TYPE_	_FREQ_	UPRICE	ANNUALD	NUMREQNS	EOQR
76	5910010193677	1	1	55.00	49	27	12
77	9688LKA120694	1	1	82.00	27	27	8
78	2840001096540	1	1	72.00	50	26	11
79	2910001047385	1	1	275.04	31	26	4
80	5360008681869	1	1	2.42	35	26	50
81	2995000753875	1	1	6.40	25	25	26
82	5330010059049	1	1	0.20	1638	25	1193
83	5365008999164	1	1	0.19	97	25	298
84	6680008157282	1	1	4430.00	25	25	1
85	2840001465533	1	1	346.00	192	24	10
86	2840004327731	1	1	741.54	288	24	8
87	2840008850744	1	1	751.90	296	24	8
88	2910009631240	1	1	5.70	48	24	38
89	2915000973458	1	1	878.00	24	24	2
90	4820000706183	1	1	528.00	25	24	3
91	5310005000055	1	1	20.07	117	24	32
92	5330008574423	1	1	0.09	1757	24	1843
93	5330010059059	1	1	2.34	629	24	216
94	5930010181741	1	1	139.85	29	24	6
95	2840001598830	1	1	302.54	196	23	11
96	2840012328894	1	1	815.00	27	23	2
97	2995000764311	1	1	199.00	81	23	8
98	3020008876926	1	1	49.69	51	23	13
99	4730002785006	1	1	0.43	8035	23	1803
100	4810000753881	1	1	8.70	25	23	22
101	5365005808599	1	1	0.04	45	23	442
102	2840001711964	1	1	432.00	66	22	5
103	2910002562795	1	1	48.47	22	22	9
104	2990010515101	1	1	1620.60	24	22	2
105	3010003374796	1	1	13.68	168	22	46
106	4320000724592	1	1	51.30	129	22	21
107	5310004563753	1	1	14.68	49	22	24
108	5360009649028	1	1	0.30	70	22	201
109	1650004275923	1	1	17330.00	21	21	1
110	2620001654043	1	1	296.00	21	21	4
111	2910004111118	1	1	17.51	49	21	22
112	2915006599501	1	1	11.70	21	21	18
113	2915008773760	1	1	140.00	57	21	8
114	2990010511477	1	1	246.00	22	21	4
115	3120009934299	1	1	13.00	51	21	26
116	3120011520609	1	1	16.50	665	21	84
117	5305001141637	1	1	2.18	326	21	161
118	6115004941574	1	1	3402.65	119	21	2
119	9093LKA118208	1	1	1160.00	77	21	3
120	2835000214943	1	1	9720.00	20	20	1
121	2840000097606	1	1	327.00	348	20	14
122	2840000097607	1	1	290.00	198	20	11
123	2840000152226	1	1	11.95	59	20	29
124	2840002252565	1	1	523.01	115	20	6
125	2840006127712	1	1	42.94	70	20	17
126	2910004111121	1	1	11.12	28	20	21
127	2915006732655	1	1	103.00	39	20	8
128	2915006735752	1	1	162.04	47	20	7
129	2915008773761	1	1	295.00	62	20	6
130	2995008905386	1	1	72.81	25	20	8
131	3040010515100	1	1	174.66	33	20	6
132	3110002694704	1	1	239.55	85	20	8
133	3110005656439	1	1	6.84	75	20	44
134	3110010225982	1	1	74.99	380	20	30
135	5306005125327	1	1	2.71	56	20	60
136	5330008459561	1	1	0.44	49	20	139
137	5330011411818	1	1	0.32	881	20	692
138	1560011387494	1	1	90.00	19	19	6
139	1620002836966	1	1	2040.00	112	19	3
140	1630001270189	1	1	2880.00	19	19	1
141	1650007032429	1	1	170.66	19	19	4
142	1650010130942	1	1	30680.00	19	19	1
143	2840000420077	1	1	386.00	95	19	7
144	2840002225696	1	1	1740.00	19	19	1
145	2840009383673	1	1	509.00	56	19	4
146	2915006730949	1	1	55.17	37	19	11
147	3110001145348	1	1	224.00	23	19	4
148	3110001780183	1	1	985.00	87	19	4
149	3110011561062	1	1	110.00	66	19	10
150	4710010171068	1	1	19.50	20	19	13

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